AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 15, NO. 5. WEEKLY. | NEW YORK, THURSDAY, FEBRUARY 4, 1892. | $3.00 per Annum. SINGLE COPIES 6 CENTS.

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Five-foot Tire Turning Machine.

We present on this page an illustration of a boring and turning mill modified for the special purpose of turning and boring steel tires for cars and locomotives.

The principle points in which the machine differs from the regular mills made by the same company are that the housings are lower in proportion to the swing, and that the cross-rail is secured to them permanently and has no vertical adjustment. This latter feature, of course, tends toward simplicity of construction and great rigidity, and, in fact, pains have been taken to make the machine as simple and easily managed as possible, and to make all breakable or wearing parts so that they may be easily renewed. The machine can be entirely dismantled without removing it from its foundation.

The machine is driven by a five-stepped cone pulley for a 4″ belt, from which twenty different speeds are obtained with one speed to the countershaft, and, as two speeds are usually given to this, the machine can be driven at forty different speeds, so that the maximum speed for any given metal or condition can be obtained. Power is transmitted through cut gears to the table, which is driven by an internal gear near the periphery, which has teeth of peculiar form which have been found to run very well, even when much worn.

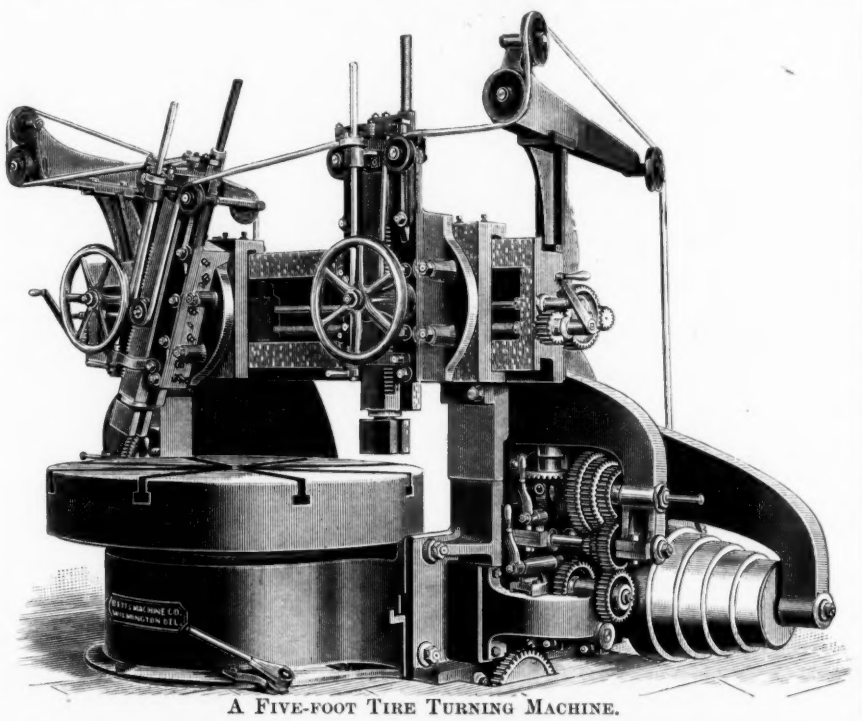
The table, which is unusually heavy, is supported upon a steel step when running at the higher speeds and upon an annular bearing near the edge when running slowly upon heavy work.

The heads are adjusted and fed independently, there being six rates of feed, the motion for which is transmitted through gears and screws, giving a positive feed, and one in which all stress is removed from the teeth of the gears, except when they are actually moving the tools. Quick returns are supplied to all motions of the heads and bars.

The bars are of square section, bearing upon flat surfaces which are scraped to a bearing and can be adjusted. They are counterbalanced in such a way that the weights by which it is done are entirely out of the way of the operator.

The uprights are of box section, heavy, and securely fastened to the bed and to the cross-rail. Shafts and all pinions are of steel and the boxes are lined with brass bushings, which can be easily renewed.

The size illustrated, which is of five feet nominal capacity, takes 14″ under the rail, has 18″ travel of tool bars, a table 60″ diameter, and will swing about 68″. It weighs 32,000 pounds, and is built by the Betts Machine Company, Wilmington, Del.



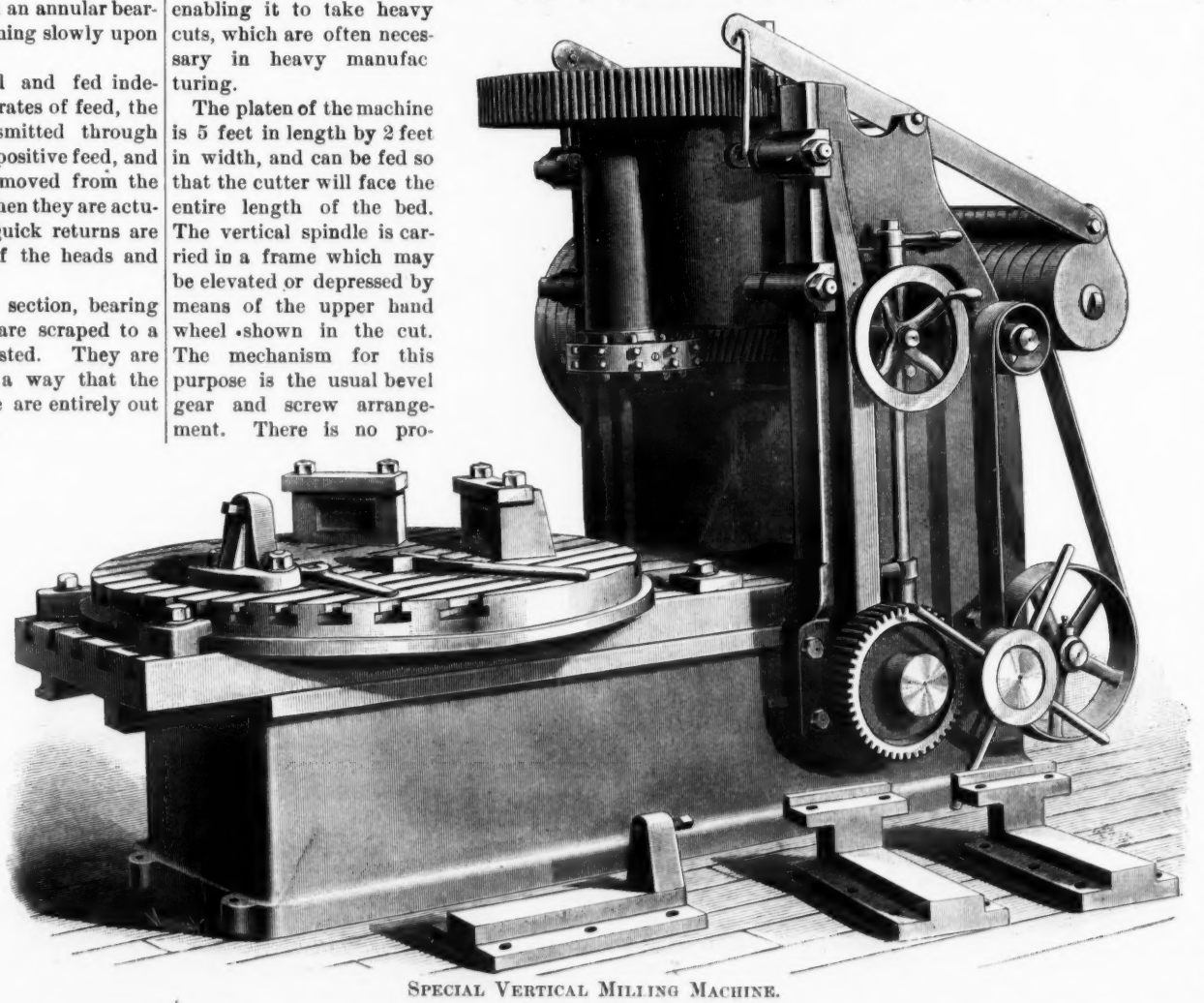
A FIVE-FOOT TIRE TURNING MACHINE.

While machine tools have been increased almost enormously in weight within the past twenty-four years, skill in their manufacture makes them as easily handled as ever.

Special Vertical Milling Machine.

This machine was designed for special work, and is, therefore, not adapted to a wide range of operations. It is very heavy in all its parts, with powerful driving gear, enabling it to take heavy cuts, which are often necessary in heavy manufacturing.

The platen of the machine is 5 feet in length by 2 feet in width, and can be fed so that the cutter will face the entire length of the bed. The vertical spindle is carried in a frame which may be elevated or depressed by means of the upper hand wheel shown in the cut. The mechanism for this purpose is the usual bevel gear and screw arrangement. There is no provision for horizontal adjustment of the cutter. It is necessary to bolt the work in such position on the platen that the parts to be faced come in line with the cutter. While the absence of this adjustment, which is so usual in machines of this character, limits the range of work that can be done, it enables the machine to be made much more rigid and simple, as the number of joints between the cutter and the work operated upon are reduced to a minimum. The spindle is counterweighted, so that the vertical adjustment is easily made, and when adjusted in position is secured by bolts, clamping the spindle frame to the uprights of the machine. The cutter can be raised high enough to accommodate work 15 inches thick.



SPECIAL VERTICAL MILLING MACHINE.

The spindle is 5″ in diameter at the lower end, and has a bearing over its entire length. It is slightly tapered to facilitate perfect fitting, and also for taking up wear, and to the upper end is directly attached a spur gear 24″ in diameter, with 4″ face. This gear is driven from a pinion in the rear, which slides up and down on a vertical splined shaft when the adjustments for height are made. The lower end of this vertical shaft carries a worm gear which engages with a worm on the horizontal shaft, supported in bearings in the housings. The driving pulley is on the opposite side from that shown in the cut, while the feed is taken off from the small pulley shown in front. The proportions of the gearing are as follows:

Driving pulley, 24″ in diameter by 5″ face; worm gear, 12″ in diameter; worm has 4 threads, each about 1″ pitch, so that the ratio of the worm to the worm gear is about 9 to 1; the spur pinion driving the large gear is 6″ in diameter, making the ratio between the spur gears 4 to 1; the entire ratio being about 36 to 1.

It will therefore be seen that the driving mechanism is exceptionally strong. The feed is operated by belting from the driving shaft down to the countershaft near the base of the machine, as shown. This shaft, as well as the other two heavier shafts, extend through to the opposite side, where a double set of worms and gears reduce the speed to the proper amount to give motion to the heavy shaft, carrying the spur gear as indicated. This shaft also carries a spur gear in the center of the bed, which engages with a rack on the table, similar to the driving gear of the planer. The lower hand wheel shown in the cut carries a pinion which meshes with the spur gear, as shown in front. This enables the table to be controlled by hand. The circular face-plate, shown on top of the platen, is a special chuck designed to hold work, on which there may be several parts or bosses that require facing off. The several parts can be brought successively in line with the cutter by loosening the clamp bolts and turning the work by hand to the required position, a center pin being provided to keep the face-plate in position on the bed. The automatic feed is thrown in and out by means of the upright shaft and lever shown

just back of the hand wheel. As this machine is designed solely for manufacturing purposes, it was not deemed necessary to provide for extensive adjustments in any direction. The rate of feed is governed by the size of pulleys, represented in the front, four pulleys being provided for this purpose, two only being in use. The largest and smallest size are shown in the cut. The two intermediates are of such diameter that, when used, the same length of belt will drive. These pulleys are splined, and easily pulled off the ends of their respective shafts, when the change of feed is desired. By reversing the pulleys shown in the cut, the fastest rate of speed will be obtained. The two intermediate pulleys also give two rates of feed, which are sufficient for all ordinary purposes.

The aim of the designer has been to obtain a very stiff, rigid tool, with but few working parts, and one of sufficient driving capacity to take the heaviest cuts without jar or chatter in the work.

The machine complete weighs about five tons, and is capable of taking a cut 10″ wide, 1″ deep, with a feed of 3″ per minute in cast-iron, or will remove about 30 cubic inches of stock per minute. The machine was designed and built by C. E. Lipe, Syracuse, N. Y.

A Remarkable Surface Gauge.

BY A. D. PENTZ.

This surface gauge is the original of its kind. It was designed and made by George Wincock, a celebrated tool maker in the old gun and early sewing machine days. It was made in the Mott street factory of The Singer Co. about the year 1867, perhaps before.

In 1868 rumors of a remarkable tool of this kind became the subject of shop talk among tool makers in New York City, in Hartford, in Boston and elsewhere, in consequence of the migrations and professional tours of members of that aristocratic guild of mechanics who had seen and described it.

Tool makers in those days were favored creatures, and Wincock was a king among them. He went into the shop in the morning dressed in faultless fashion, in gloves and silk hat. Imagine a man standing at the vise, in lavender trousers and a duck vest, with his shirt cuffs rolled back, and a silk handkerchief for an "apron." The handkerchief corners would be tucked into his vest pockets for a fastening. Then believe the still more marvelous fact that neither of the garments would be soiled, and the "apron" would last a week, quite clean, and a man thus clothed would do as much first-class work as any other man then or since. Wincock was a whole man in shop and out of it, and many of the old-timers remember his kindness of heart as well as his other peculiarities.

I first saw this gauge in 1869. Afterward it did good service in the United States Watch Factory, Marion, N. J., in 1872–'73, where Wincock and myself were tool makers. I went to Chicago in 1873; Wincock arrived in '74, and began a mercantile career. Having no further use for this tool, he gave it to me, first to show to some of my friends, and when I carried it back, he said, "Keep it; you are the only man out here that knew me at the bench, and you have use for it, I haven't." He told me that it cost him about one hundred and fifty dollars to make.

I still possess it, and it has continually reflected credit on its designer. Every mechanic accepts its decisions, when it is carefully applied to use. Its service to me personally is and has been incalculable. I have been able to prove perfections and to detect errors with this instrument, which, without it, would in certain cases either have cost its value to provide as accurate special appliances for, or the results obtained would have been in doubt.

While the readings on the scale have no positive values, a person experienced in using this gauge, can detect differences of less than .0003″ between one height and another when they are compared.

Fig. 1 is the front elevation of this gauge. Fig. 2 is a horizontal section cut through the base, showing the construction of the peculiar ornamentation of that part, and the shape of the seat below it. Fig. 3 is a horizontal section through the head, and Fig. 4 is a view of the bracket *H*, showing its construction and the arrangement of the worm *K* upon it, as well as the hub *I*, by which the whole head is attached to the support *G*.

I never saw one of these gauges made, and do not know how all the operations on it were performed, but I do know they can be made. The base *C* seems to be bored, as indicated by the dotted lines, and the column *G*, with the surbase *D*, is in one piece, is let through the base *C*, and fits it tightly. If this column, after it has been roughly turned, is carefully trued in a chuck on a dividing head, with the lower end outward, and placed before a drilling head at the proper angle, and one hole carefully drilled to the size of the small end of the taper

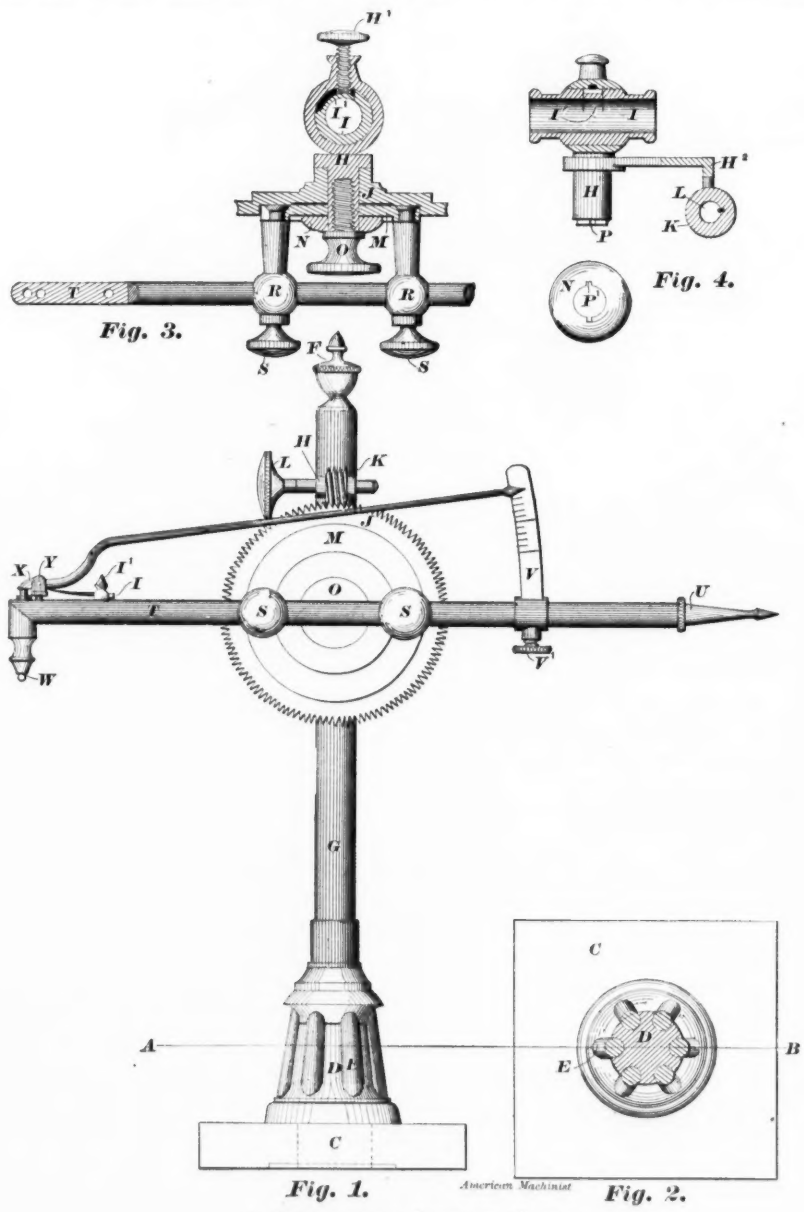


Fig. 3. Fig. 4. Fig. 1. Fig. 2.

A REMARKABLE SURFACE GAUGE.

plugs *E*, which make the convex fluting in the surbase, then, if the dividing head should be turned one-sixth the circle and another hole drilled, and thus for the remaining four holes, each to the proper depth, all would be located in their proper positions. It is understood, of course, that there is solid stock all about these holes when they are drilled, and that the holes extend by a short distance above the tops of the flutes visible in Fig. 1. The plugs *E* seem to have the taper of the ordinary pentagon pin broach, so I presume they were reamed by hand. After reaming, they should be fitted with temporary plugs, which should be well greased and driven in snugly. The plugs should be of brass, so that the color may guide the turning operation, because it is probable that the joints will not otherwise be seen in turning and polishing the surbase. After the column is completely finished in every other particular, these temporary plugs are removed, and others of polished steel are driven into their places, giving the effect shown.

The cap *F* is an independent piece, and at its knurled flange is larger than the column *G*, to prevent the accidental removal of the head. The top of the column is drilled and tapped, and the cap *F* is provided with a screw stem which fits it, the joint being directly under the knurled flange.

The base *C* on this column is soft steel, and as such is inferior, because it catches grit and scratches on a surface plate, hence this base and column have not been used by me. In its place I had made a hardened steel base of circular outline, to which was fitted a column double the height of this one. This overcame the trouble.

The bracket *H*, shown in Figs. 3 and 4, has within the hub *I*, which fits the column *G*, a spring shoe or gib I^1, which covers the point of the screw H^1, and prevents it marring this column. The probable construction of this gib is indicated by these sections. I can find no joint, but believe the sleeve *I* to be inserted within the bracket *H*, after the gib has been made, as shown. The worm extension H^2 seems to be a solid part of the bracket *H*, which it may very well be. It is presumed that the worm is keyed on, as shown in Fig. 4.

The worm gear *J* loosely fits the bracket H^2, and engages the worm *K*. It is recessed to receive the circular plate *M* of the adjustable stock *M R R*. This plate *M* is penetrated by the hub of the bracket *H;* it is covered by the washer *N*, and clamped by the screw *O*. The dowels *P* enter the slots P^1 of the washer *N*, and prevent its turning. The worm *K* is used only in fine adjustment. When the screw *O* is loose, the adjustable stock *M R R* may freely be turned to any position, because the plate *M* is circular, and fits loosely a circular seat. When the screw *O* is partly tightened the worm can adjust, but when wholly tight it holds the stock rigidly in its position.

The stock *M R R* supports the gauge arm *T*, and secures it to the required position by means of the screws *s s*. The beak of the arm *T* is bored vertically, of a parallel small size, to which is fitted very carefully the plunger *W*, to not shake, but be quite free, so as to slide endwise with perfect ease. This plunger is kept in place by a shoulder which rests on the arm *T*, and it has a small hemispherical tip, which receives the short arm of the index *X*. This index *X* is pivoted in the fulcrum post *Y* one-tenth of an inch from the center of the plunger *W*. It must have perfect freedom on its fulcrum, and be well guided in its position. The spring *I* is attached to the post I^1, and has a stiffness just sufficient to surely overbalance the weight of the index arm, and keep a pressure upon the plunger *W*. The value of this gauge as a delicate instrument depends on the adjustment of these parts, but when they are correctly set they will remain so for years. Since I have had this gauge it has required two new plungers and one new spring.

The scale *V* has been lost many years. It is of but little value, because it is found better to gauge from a touch, or when the plunger *W* just touches the work, so that the index at its outer end is perceptibly disturbed.

The scratch point *U* is hardened, and screws into the arm *T*, precisely as cap *F* does into *G*. It has never been used.

The uses of these special features should be clear to every mechanic, where they apply to the detection or the confirming of heights and parallels, and it is only necessary to say that it is better practice to set the gauge to the lower piece or end, and at the higher place to place paper of uniform thickness under the base of the gauge, until the difference is equaled. Then measure the paper with a micrometer gauge. Handle the gauge with a cloth tied to it, wherever the hand comes in contact, because a warm hand will expand a length of four inches, about three-thousandths of an inch at times. This has explained many contradictions in my experience.

In turning or grinding cylinders this gauge will give the truth of the result, and frequently surprise the operator, who imagines he is getting a perfectly concentric job. To do this, stand the gauge on a flat, rigid surface, and let the point of the plunger *W* rest on the top of the revolving surface. The index will show whether the work is true, eccentric, or not round. If true, the index will stand dead still. If eccentric, it will rise and fall regularly. If not round, it will rise and fall irregularly.

Work in lathes being trued up can be proved in the same manner by this gauge. Lathe centers, milling arbors, and in fact all arbors can be inspected by the same method. Face-plates and shoulders can be tried for truth as well as cylinders, by turning the gauge arm one-quarter way over, to meet them squarely. In fact, every rotating piece may be inspected perfectly for truth by this tool.

In the sketch here given the actual sizes are maintained, and it is believed that the device is fairly well shown. Considering the fact that it was designed and made twenty-five years ago, it is wonderful that it exhibits so much that has been proved to be correct practice, and if it were a production of to-day it would be considered as being ahead of progress rather than behind it.

It is gratifying to notice in the catalogues of some of the best makers of small tools, new gauges which operate on the same principles as this one.

As we predicted some time since, the miners and the militia in Tennessee have come to the point of opposing one another force for force. The State insists upon leasing its convicts to work in the mines, and the free miners object. We do not expect any serious amount of bloodshedding in the matter, as it is probable the miners largely outnumber the militia, and about every one in that part of the world knows the use of a gun. Moreover, it is more than probable that the majority of the militia of the State thoroughly sympathize with the miners in the misunderstanding of the case in issue. It is a hard operation—the enforcing of an obnoxious law.

The "Triumph" Belt Shipper.

We present with this, engravings of a German invention, which is intended to do away with the danger incident to putting belts onto pulleys when in motion.

Any one who has an opportunity to examine the reports of the factory inspectors of the various States will find that this matter of the danger attending the operation of putting on belts, as ordinarily done, is receiving an increasing share of attention, the tendency being to require more and more strict compliance with the requirements as to safety devices, and to be more and more severe in the infliction of penalties for accidents which are shown to result from the lack of proper appliances that have been shown to be conducive to safety.

The laws of many States specify that safety appliances shall be used, and factory inspectors are showing an increased disposition to insist upon it that these laws shall be observed. Their reports show that a very large proportion of accidents result from efforts to place belts while the shaft is running. In Germany the science of accident prevention in factories is more highly developed than here—perhaps more so than in any other country—and the device which we here illustrate has made a good record there, and is used in many of the leading establishments.

Figs. 1 to 5 show the construction of the shipper, and by reference to them it will be seen that the central idea of the device is the sliding or expanding head, which allows the roller that passes under the belt to pass around the pulley, without at the same time necessarily changing the position of the handle or staff.

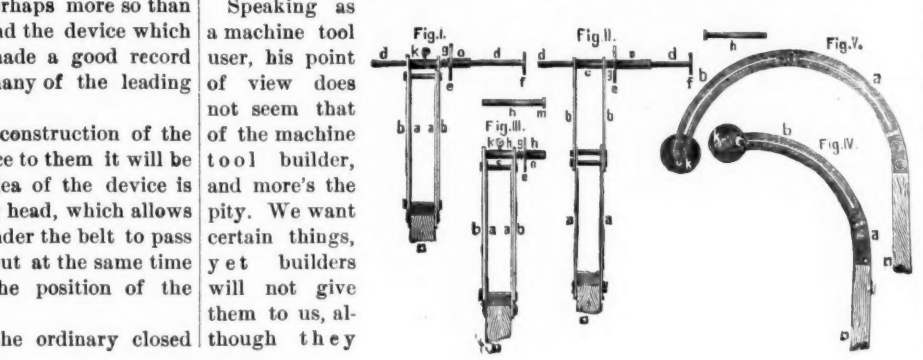
Fig. 4 shows it in the ordinary closed position ready to be applied to a belt, and Fig. 5 its position after it has passed over the pulley and the belt is in place. Fig. 2 gives a view showing the arrangement of the rod, flanges, etc., for a wide belt, the flange *f* passing over the farther edge of the pulley, while the belt is held between flange *f* and flange *e*, the spring *g* allowing for any inequality in the width of the belt. Fig. 3 shows the arrangement for a narrower belt, the shorter rod *h* being used in this case. When the device is to be used on the other side of the pulley, it is only necessary to pull out the rod and insert it from the opposite side.

Figs. A1 to A3 show the action of the device when used in the ordinary way, A1 being the position when the belt is first taken up with the pulley running in the direction indicated by the arrow. It will be noticed that the head is here shown contracted. Fig. A2 shows it in position, with the belt lifted up, and about ready to engage with the pulley—the critical and dangerous position when the work is done by hand. Fig. A3 shows it in the third position, the belt being in place and running, and the head having been extended, to allow the roller to pass over the pulley with the belt, thus obviating all danger to the workman.

Figs. B1 to B3 indicate the method of using when the pulley runs in the opposite direction, the successive positions being in their numerical order, as shown, up to B3, after which the operation is simply the reverse of that shown above, the head contracting as the roller passes over the pulley, instead of extending as before.

It will be understood, of course, that the workman stands upon the floor while using the shipper, and it will at once be seen that, besides being safer than the ordinary methods, a considerable proportion of the time required to handle belts is saved, not only because all climbing of ladders, etc., is done away with, but because the first trial at placing a belt is successful, instead of a number of trials being required, as very frequently happens where the hands or a stick are used.

The device is being introduced in this country by Peter A. Frasse, 95 Fulton street, New York City.



THE TRIUMPH BELT SHIPPER.

A Suggestion and Some Criticisms.

BY W. D. FORBES, M. E.

In starting another year, the writer has been looking over the field in which he works for certain signs which he hoped would have, by this time, become something more than the hoped for.

Speaking as a machine tool user, his point of view does not seem that of the machine tool builder, and more's the pity. We want certain things, yet builders will not give them to us, although they admit that what we want is not only reasonable, but would be advantageous to them to give.

For instance, we want a standard diameter, length and thread on lathe spindles; this point has been so well written up, that there is little hope of anything being done by the builders, and it does not seem practical to get the users well enough together to have a command from them go forth saying that no lathe would be bought by any of the members unless the chuck threads conformed to a standard given by them, yet such a thing is possible to accomplish.

We are now at the mercy of lathe makers' individual ideas, some good, some bad, but in the opinion of the writer the very worst ideas on this point, if made the absolute standard, would be a blessing which only our generation could appreciate.

The idea hinted at above would have the advantage of saving the vanity of lathe builders who, to use a slang expression, seem "stuck on themselves," while admitting that standard threads for spindles of lathes is a desideratum, think nothing better could be done than to take what they make as the standard. This idea seems possessed by every lathe builder, from the makers of the one lonely lathe of a great Providence company, to the manufacturers of endless sizes in the city of Cincinnati. They argue: "We have selected the best, and other makers of lathes are wrong, so they must come to us for a standard." With such a sentiment, progress is out of the question; it looks as if our only hope is in ourselves, and *we*, as yet, are not, so the standard lathe spindle is as hopeless as ever. If 1892 could only be known as the standard lathe spindle year. It can, but it is safe to say it will not.

It has no doubt struck others, as it has the writer, that in many machine designs some details are worked out with great study and care, while others of equal importance are made any way the draftsman happens to draw them. Some most strange things can be noticed, not affecting, perhaps, the working of the machine, but showing great incongruity, as for instance, on a beautiful milling machine the hinges of the door in the base are of the ecclesiastical order, being ornate crosses, hard to clean, and absurdly out of place, even on so good a tool.

Again, in the catalogue of a certain company which is noted for its fine gears and perfect proportions, can be found a gear, illustrated, which looks as if it never was designed, but was knocked together by some flask maker, and even the great reputation of its maker cannot save it from being smiled at by hundreds.

Sometimes this lack of study affects the value of a tool; as, for instance, the placing of shaper belts on the left of the tool, where the operator cannot reach them without stretching over the ram. Again, in a cutting-off machine for 6" stock, no provision is made to bring the cutting tool to an exact position other than by pushing the bar of stock in and out, making close work very costly. With one exception, lathe makers cling to four legs for short beds, making vibrating machines out of the tools, even when set with great care; there may be more than one maker who knows the proper number of points on which to set a lathe, but if so the writer has failed to notice it.

One more practice seems most curious, and that is making a combination of a machine tool and a book of instructions; it may do no harm, but what good it does is hard to see.

It is generally unhealthy in any well run shop for a man to drill into a drill press table, or strike a shaper vise with anything but a lead hammer, and, in a shop where the abuse of tools is allowed, no amount of cast-iron instructions on a machine will prevent it.

Shipbuilding in the Royal Dock Yards During 1891.

Industries, London, gives the following particulars relating to shipbuilding in the royal dock yards during the year 1891.

The year 1891 will be remembered in the dock yards as having been one of unusual activity, since the aggregate tonnage floated, when measured by displacement, reaches 68,100 tons, which is more than three times the amount put into the water during the preceding year, and nearly double the quantity launched in 1889. Rapidity of construction is now the order of the day in the government establishments, and the work accomplished during the past twelve months has presented the shipbuilding capabilities of the royal dock yards in a wholly new light, and has fully proved the statement made by Lord George Hamilton, some time ago, in an address on the "Naval Policy of the Government," that, in "our royal dock yards we could build ships 50 per cent. quicker than any other nation." The rapid and economical progress made in the construction of the battle-ship "Trafalgar," when upwards of 5,500 tons of material were worked into her structure in sixty-seven weeks, was regarded as phenomenal; but smart as this achievement may be considered, it has been eclipsed in the building of the first-class battle-ships ordered from the dock yards under the Naval Defense Act. The "Royal Sovereign," launched at Portsmouth in February, was only seventeen months on the blocks, and her launching weight was fully 7,200 tons. She is now so far advanced towards completion that it is anticipated she will be commissioned for

active service before midsummer. Two other vessels of the same type—namely, the "Empress of India" and the "Hood"—were launched during the year, the former at Pembroke and the latter at Chatham, both within two years of their commencement. These vessels are each of 14,150 tons displacement, and were specially designed to take part in general fleet actions in European waters. They are armored and gunned alike, and, excepting that the "Hood" mounts her heavy armament in turrets instead of barbettes, they are in other respects identical. The propelling machinery for the whole of this type under construction in the dock yards is being supplied by Messrs. Humphrys, Tennant & Co. Two first-class cruisers similar to the "Edgar," which has recently been tried with such success, were also removed from the blocks—the "Royal Arthur," at Portsmouth, and the "Hawke," at Chatham. These vessels are intended for commerce-protecting purposes, and are large enough for independent roving in any part of the world. The steel bottom of the "Royal Arthur," which has a displacement of 7,700 tons, is sheathed with wood, and in this respect only does she differ from her sister the "Hawke." This difference, however, credits the former with 350 tons more displacement, and will diminish her speed, as against that of her sister, by about a quarter of a knot. The "Hawke," which is all but ready for her trials, has been engined by the Fairfield Shipbuilding and Engineering Company, Govan, while the machinery of the "Royal Arthur" is being fitted on board by Messrs. Maudslay & Co., London.

To the total output for the year, Devonport, Sheerness and Chatham each contributed a second-class cruiser of the "Latona" type, named "Æolus," "Brilliant," and "Apollo," respectively. The two former are sheathed with wood, and have each a displacement of 3,600 tons, while that of the latter is 200 tons less. Like the first-class cruisers, these vessels are also intended for the protection of our mercantile marine, and with their great speed and heavy armament, associated with a strong defense over their most vital parts, they have no reason to fear an encounter with most foreign ships of similar size. The machinery of the "Æolus" and "Brilliant" have been supplied by Messrs. Hawthorn & Co., Newcastle-on-Tyne, while that of the "Apollo" has been constructed by Messrs. Earle & Co., Hull.

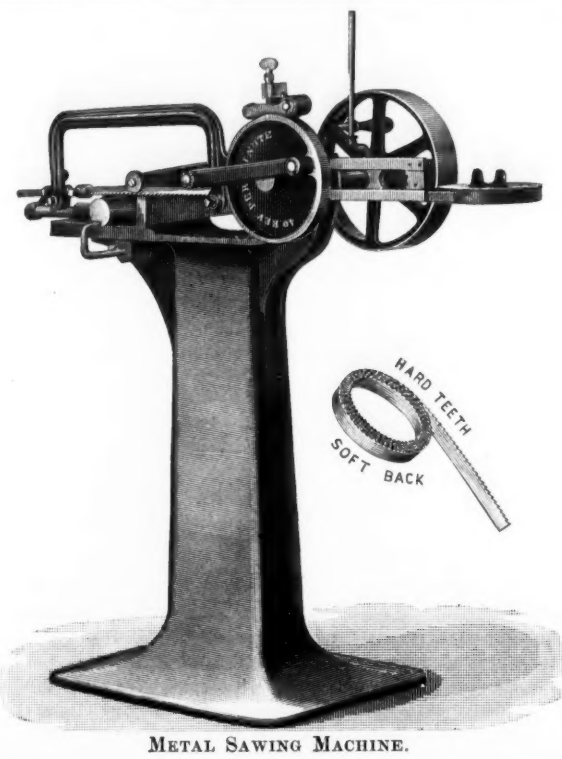
The following tabular statement contains the particulars of the vessels referred to:

Name of Ship.	Length. Feet.	Breadth. Feet.	Mean Draught. Feet.
Empress of India..	380	75	27.5
Hood.....	380	75	27.5
Royal Sovereign...	380	75	27.5
Royal Arthur.....	360	60	23 75
Hawke.....	360	60	23.75
Æolus.....	300	43.6	17.5
Brilliant.....	300	43 6	17.5
Apollo.....	300	43.0	16 5

Name of Ship.	I. H. P.	Speed. Knots.	Coal Capacity. Tons.
Empress of India..	13,000	17.5	900
Hood..	13,000	17.5	900
Royal Sovereign...	13,000	17.5	900
Royal Arthur.....	12,000	19.5	850
Hawke.....	12,000	19.75	850
Æolus.....	9,000	19.75	400
Brilliant.....	9,000	19.75	400
Apollo.....	9,000	20	400

Metal Sawing Machine.

We illustrate herewith a machine for sawing up stock into lengths, it being adapted for sawing any kind of metal that can be filed and for holding any shape. It is in reality a power driven hack saw, the advantages of it being that it does its work after being set and started, without further attention. Saws are not so often broken, there is very little waste of stock, and square, smooth cuts are made. Lengths of saw blade are used 25 feet long, that part not in use being coiled up at the back and drawn forward to the frame and clamped as needed, that that has been dulled by use being broken off and thrown away. The stroke is 7″ and stock up to 5″ square can be cut. The machine is made by Henry G. Thompson & Son, Elm and State streets, New Haven, Conn.



METAL SAWING MACHINE.

Limiting Numbers of Involute Bevel Gear Teeth.

BY GEORGE B. GRANT.

LEXINGTON, MASS.

In all tooth systems a limit is set to the smallest numbers of teeth that will work together, and these limits will vary with the system chosen and with the requirements made.

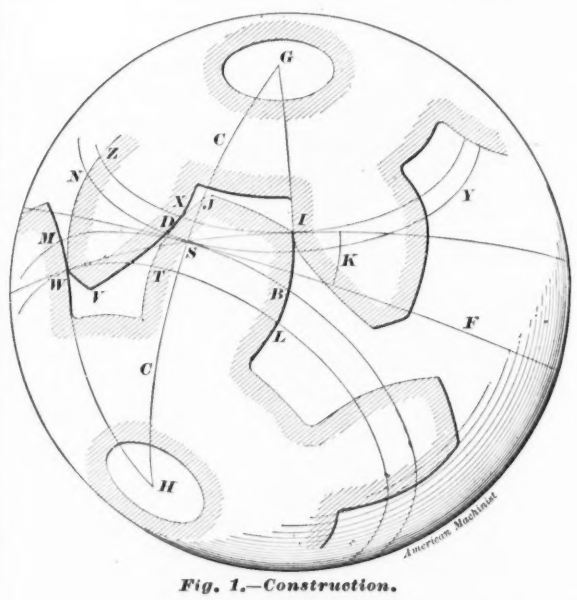


Fig. 1.—Construction.

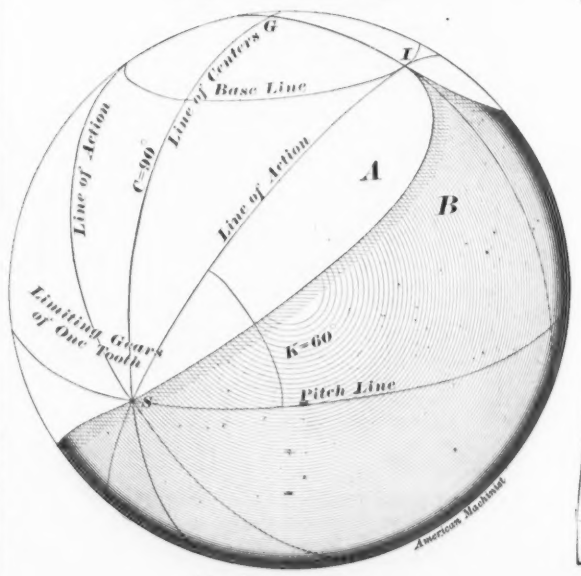


Fig. 3.—One Tooth.

The purpose here is to study the same problem as applied to interchangeable involute bevel gear teeth, and to determine the conditions under which such gears of one, two, three, and four teeth will work together.

It should be stated that bevel gear teeth differ from spur gear teeth in very few points, the principal difference being that the former are drawn upon the surface of a sphere, while the latter are drawn upon a plane surface. The general theory and method of investigation is the same in both cases, being much more difficult, however, in the case of the bevel gear, for the spherical surface takes the place of the plane, and the great circle is the substitute for the straight line.

A spherometer must be provided for this study, as it is useless to attempt the problem on a plane surface. A painted wooden ball, four to six inches in diameter, Fig. 2, fitting in a ring, will serve the general purpose and illustrate the gears very well, but a large papier maché globe and graduated brass ring are essential if accuracy is required.

The reader is supposed to be familiar with the general theory of the involute spur gear tooth, and to know the names, positions and properties of the various points and lines.

We will first take the simplest problem, to determine the least numbers of teeth that can be used on bevel gears having given center angles and a given angle of obliquity. In Fig. 1 the axes *G* and *H*, the center angles *GS* and *HS*, and the angle of obliquity *ISF*, are given.

Draw *GI* and *HW* from the axes at right angles to the line of action *IW*, locating the interference points *I* and *W*, and draw the pitch lines *MSB* and *NSY*, and the base lines *LW* and *IZ*. Draw the involutes *IBL*, *MW*, and *WNZ*; bisect *BM* at *D*, and draw the involutes *JDT* and *VX*, thus completing the teeth. The desired least numbers of teeth for the given center angles and obliquity can be found by dividing the whole lengths of the pitch lines by the whole tooth arc *MB*, and any two numbers of teeth not less than these will work together.

The above process, although it is always correct for the large numbers of teeth in ordinary use, where the obliquity is generally large as compared with the center angles, may fail when four teeth or less are involved, for then the point *J* may fall on the right of the point *I*, so that the curves will cross and practical action be impossible. For example, if we attempt to draw a pair of miter gears with three teeth, the center angle being 45 degrees, the tooth will have a crossed point at *IJ* and fail to act, no matter what obliquity is chosen, so that the three-toothed miter gear is impossible.

To determine the conditions that will permit the operation of small numbers of teeth we must find the conditions that shape the tooth that is just pointed at the interference point, while it also passes through the pitch point; for in that case a pair of equal gears will just work together, and no smaller number of teeth can be allowed with that center angle.

In Fig. 2 the point *S* is the pitch point, the axes of the gears are at *G* and *H*, *I* and *W* are the interference points on the base lines, *ISF* is the angle of obliquity *K*, and *WSI* is the line of action for a pair of limiting bevel gears. We have to determine the obliquity that permits the tooth curve to pass through the interference point and the pitch point at the same time.

The solution of the problem is by the tentative process of repeated trials. The obliquity and the center angles are chosen at random, and the figure constructed. It is a property of the involute curve that the distance from any point along the tangent to a point on the base line is the same as from that point back on the base line and along a

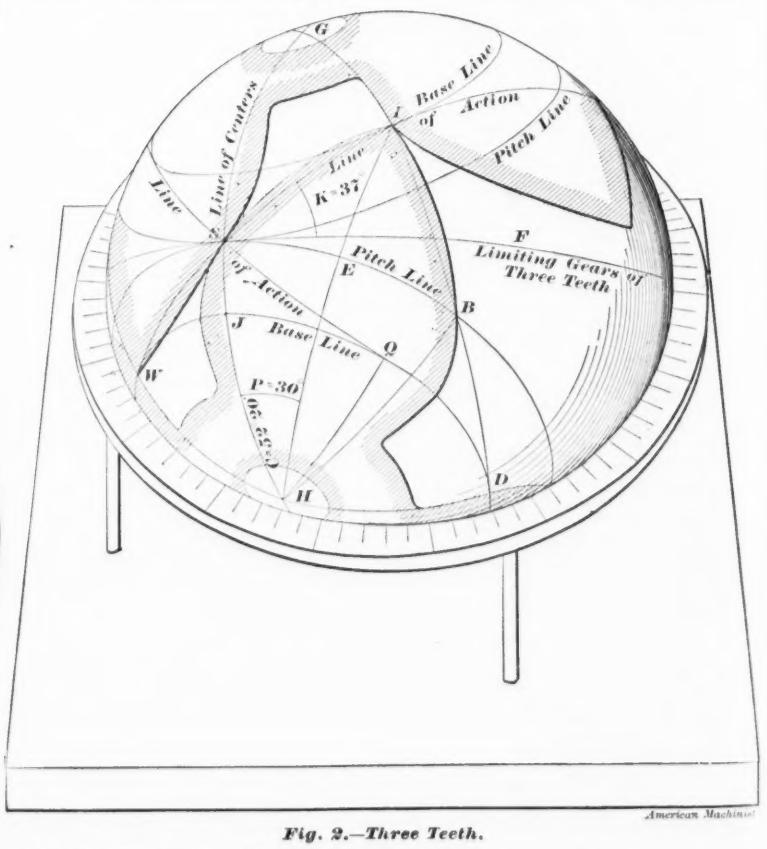


Fig. 2.—Three Teeth.

LIMITING NUMBERS OF INVOLUTE BEVEL GEAR TEETH.

For example, in the interchangeable involute system for spur gears the limiting number of teeth is 4.62, and, therefore, five is the smallest number of teeth that can be used for external work, although four teeth will work with an internal gear, and four, three, two and one tooth will work if the

tangent to any other point on the curve, and, as I and S are the known points on the curve, we have to find the center angles and obliquity that will make ID equal to DQS. If the first trial does not meet that condition, a second one is made, and the process repeated until the two distances are just equal. Then the angle IHS is the quarter tooth angle, and the limiting number of teeth for the center angle chosen is found by dividing 90 degrees by that angle.

For example, we wish to find the smallest possible number of teeth for a pair of miter gears. Our center angle is 45°, and we assume for the first trial an obliquity of 35°. Constructing the figure it is found that DQS is much longer than DI, and the curve from I would pass inside of S, the obliquity being too small. Next, increasing the obliquity, we choose an angle of 37°, and, on reconstructing the figure, find that DI is now longer than DQS, showing that the new obliquity is too great, and that the curve from I would pass beyond S. It is observed in the second trial that the curve passes about as far beyond S as it fell short of it on the first trial, and, therefore, it is judged that the true value of K is about midway between the trial values, at about 36°. Trying an obliquity of 36° it is found that the curve passes directly through S, and the problem is solved. Drawing III, the angle IHS measures 26½°, and, therefore, there are 3.4 teeth in the limiting miter gear, four teeth being the smallest whole number that will work.

To determine the center angle and obliquity of a limiting gear of a given number of teeth is a much more difficult problem, for in that case there are two parts to be found by trial. A center angle is chosen and an obliquity found for it as before described, and the quarter tooth angle measured. If that angle is not the known angle for the given number of teeth, another trial must be made, and others, until the desired angle is obtained. For example, we have in Fig. 2 to determine the limiting gear for three teeth, knowing that the angle IHS is 30°, and we try various figures until it is found that an obliquity of 37° and a center angle of 52° will give the quarter tooth angle of 30°.

Figs. 2 and 3 show the forms of limiting gears of three and one teeth respectively, thus determined. The gears of three teeth appear and act so much like ordinary spur gears that further explanation is not necessary.

The single-toothed gear of Fig. 3, however, is so peculiar that its construction and mode of operation needs explanation, although it is an actual gear having a correct action, and capable of being practically constructed and used. The figure shows the construction as well as any single figure can show it, the reference letters being the same as in Figs. 1 or 2. The center angle is 90°, A the shafts being in line. The light portion of the sphere is the gear on the axis G, and the dark portion B is the gear on the opposite axis. The action is not a sliding of teeth on each other, but, as with all crown gears, the two surfaces coincide completely, and the action is practically that of a pair of clutches.

Having determined the details of the limiting gear of a given number of teeth the problem is solved, for that gear will not work with a gear having a smaller center angle than its own, and will work with any larger gear up to the crown gear, or gear having a great circle pitch line.

The numbers of teeth in external pairs involving few teeth are limited by the fact that the corresponding crown gear does not always have one full tooth more than the limiting gear. For example, the single-toothed gear will work only with another like it, because its center angle is 90°. The limiting gear of two teeth will not work with three teeth, because its crown gear has but 2.02 teeth; three teeth will work only with three teeth, because the crown gear has but 3.8 teeth; but the gear of four teeth will work with any number up to its crown gear of 7.7 teeth.

Therefore, when four or less teeth are involved, we can have only the pairs—1x1, 2x2, 3x3, 4x4, 4x5, 4x6 and 4x7, and all other pairs, such as 1x2, 3x4, 3x7, 4x8, and 3x17 are impossible.

When we try the limiting number of 4.62, we find that the center angle is zero, and the gears are spur gears.

Above 4.62 there are no limiting numbers of teeth, as gears of 4.62 or more teeth will work at any center angle.

The mathematical treatment is not difficult, as it involves only the solution of spherical triangles, but it is very tedious on account of the great amount of work to be done.

When, as in Fig. 1, we have to find the least numbers of teeth for a given obliquity and center angles, we have the required numbers of teeth:

$$T = \frac{360^\circ \; cos.\; K}{A^\circ + a^\circ} \; sin.\; C$$

$$t = \frac{360^\circ \; cos.\; K}{A^\circ + a^\circ} \; sin.\; c$$

in which $K = ISF$, $A = IS$, $a = WS$, $C = GS$, and $c = HS$, Fig. 2,

and the corresponding maximum circular pitch is:

$$\omega = \frac{\pi}{180} \; \frac{(A^\circ + a^\circ)}{cos.\; K.} \times \text{(radius of sphere)}.$$

For example, when $C = 70°$, $c = SH = 52° 20'$, and $K = ISF = 26°$, we have $T = 3.79$, $t = 3.19$, and circular pitch $\omega = 1.56$.

As by the graphical method, we must use the process of repeated trials to solve the problem of the limiting gear. From the triangles GIS and GIH, Fig. 2, $GS = HS = C$, $IHS = P$, being the known quarter tooth angle, and ISG being the complement of the obliquity, we have the formula:

$$cos.\; C = \frac{cot.\; P}{\frac{2}{sin.\; 2\; K}} + tan.\; K$$

From the triangle SQH, in which $SQ = A$, we have the formula:

$$tan.\; A = tan.\; C \; sin.\; K$$

From the construction of the figure it is evident that the angle QHD is equal to the angle SHB, which is equal to $2P$. But, $SQ = BD$ and $SQD = ID$, and therefore $QD = QS$, and we have the formula:

$$A = 2\; P \; sin.\; C \; cos.\; K.$$

From these three formulæ we find the desired details of the limiting gear by repeated trials. We assume some value for K, and, knowing P, we compute C by the first formula. Then we compute A by both the second and third formulæ, and, if not equal, we make another trial. Two trials will give two errors which will serve to closely place the true value of K, and several trials will solve the problem.

In this way the following table of results was computed:

Number of Teeth T	Center Angle C	Obliquity K	
4.62	0° 0′ 0″	34° 11′ 0″	spur gears
4.	31° 24′ 40″	34° 50′ 40″	
3 39	45° 0′ 0″	35° 50′ 0″	miter gears
3.	52° 19′ 30″	36° 59′ 50″	
2.	70° 4′ 40″	42° 54′ 40″	
1.	90° 0′ 0″	60° 0′ 0″	

Stress in Cylinders.

BY J. MCKIM CHASE.

In determining the pressure a cylinder will bear when subjected to internal pressure, the formula:

$$\frac{T \times 2\; t}{d} = p,$$

where T is the tenacity, t the thickness, d the diameter and p the pressure. This is only approximately correct where the ratio of thickness to diameter is great, because the strength of a cylinder does not uniformly increase with a uniform increase in the thickness of the walls.

It is sometimes difficult for students to comprehend this fact, but much of the difficulty is removed if the effect of stress on straight bars is studied.

The tensile strength of a substance is the force necessary to pull asunder a square inch of its section.

The elastic strength is the force necessary to stretch it to the greatest extent that will admit of the substance recovering its normal condition when relieved of the stress.

The modulus of elasticity is the reciprocal of its extensibility, or the amount that is necessary to extend the substance, having a square inch of section, to twice its length by tension, or half its length by compression, according as the stress is applied.

The extension of a substance is found by applying the formula, $C = \frac{P\; L}{E\; K}$, where C is the change in length, P the stress, L the length, E the modulus of elasticity and K the sectional area.

Suppose a steel bar of one square inch in section and 18.8496″ long, having the following physical qualities: Tensile strength 40 tons, elastic strength 22 tons, and a modulus of elasticity of 14,000 tons. To be subjected to rupturing stress it will extend from its normal length to the point of rupture:

$$\frac{40 \times 18.8496}{14{,}000} = .053856 \text{ inch.}$$

If the bar is extended the above amount by heating it, and then securely held in that position while it is allowed to return to normal temperature, it will contract with a force equal to that required to stretch it. The increase in temperature required to extend the bar the above amount, assuming a uniform coefficient of expansion for one degree of .0000066, is:

$$\frac{.0538}{.0000066 \times 18.85} = 432° \text{ Fahr.}$$

This shows the enormous change in stress that may be produced in a metal structure by a comparatively small change in temperature.

In Fig. 1, let the inner and outer circles represent the boundaries of a cylinder of the given dimensions. According to the formula quoted for cylinders, there would be eight square inches of metal whose tenacity would have to be overcome before the cylinder would burst. But this is by no means the case, because in being subjected to an internal destructive pressure the inner circumference would be stretched to its ultimate limit, while the outer circumference would be extended but a fraction of its limit.

Suppose the cylinder to be made up of four thicknesses of one inch each, and the parallel straight lines represent the development of the different sections, and the given lengths the inner circumferences. Further, suppose the bars to be secured at their ends, and arranged so that they will all extend the same amount when subjected to tension. Subjected to stress separately, each bar would require forty tons to break it. But in the system where they all extend alike, the shortest bar would break when an extension of .053856 inch is exceeded, and the other bars would break in succession on continuing the stress. The stress on each bar when the system was sustaining its maximum load is, for the shortest:

$$\frac{14{,}000 \times .053856}{18.8496} = 40 \text{ tons;}$$

for the next:

$$\frac{14{,}000 \times .053856}{25.1328} = 30 \text{ tons;}$$

for the next:

$$\frac{14{,}000 \times .053856}{31.416} = 24 \text{ tons;}$$

and for the longest:

$$\frac{14{,}000 \times .053856}{37.6992} = 20 \text{ tons,}$$

making a total load of only 114 tons that the system is able to sustain, instead of 160 tons when each bar sustains its full load.

A similar effect is produced in rupturing a cylinder by internal pressure where the walls are under uniform tension. The break begins on the interior when the limit of extension is attained, and the balance of the walls give way in succession. It will be observed that when this limit is reached no thickness whatever would prevent the cylinder from bursting.

According to the formula quoted, which assumes the resistance of a section equal to twice the thickness of the walls, the bursting pressure would be:

$$\frac{40 \times 4 + 4}{6} = 53\tfrac{1}{3} \text{ tons.}$$

But the following, which is used in ordnance construction, gives considerably less.

Let D_2 represent the external and D_1 the internal diameter, O the strength or resistance of material, and P the pressure; then

$$P = \frac{3\,(D_2^2 - D_1^2)\,O}{4\,D_2^2 + 2\,D_1^2}$$

Substituting values

$$\frac{196 - 36 \times 3 \times 40}{784 + 72} = 22.42 \text{ tons.}$$

According to the formula you give in answer to Question No. 475, issue of October 29th, 1891:

$$P = \frac{s \times t}{r + t};$$

where s is the resistance of material, t the thickness, r the radius and P the pressure, the bursting pressure would be:

$$\frac{40 \times 4}{3 + 4} = 22.85 \text{ tons.}$$

Cylinders are increased in strength by giving the metal of the walls an increasing initial tension from the interior outward. In castings, this is accomplished by cooling

Fig. 1.

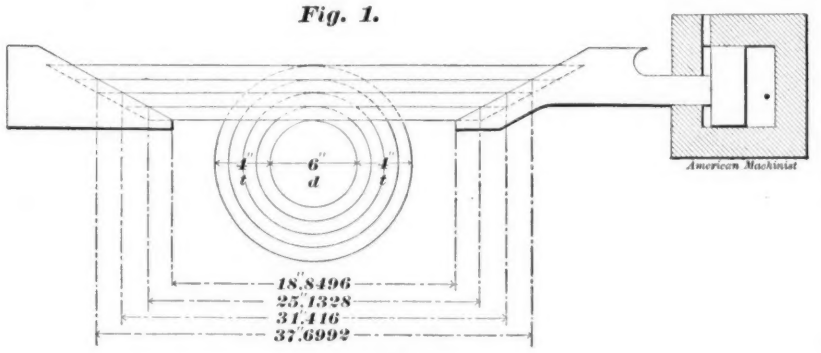
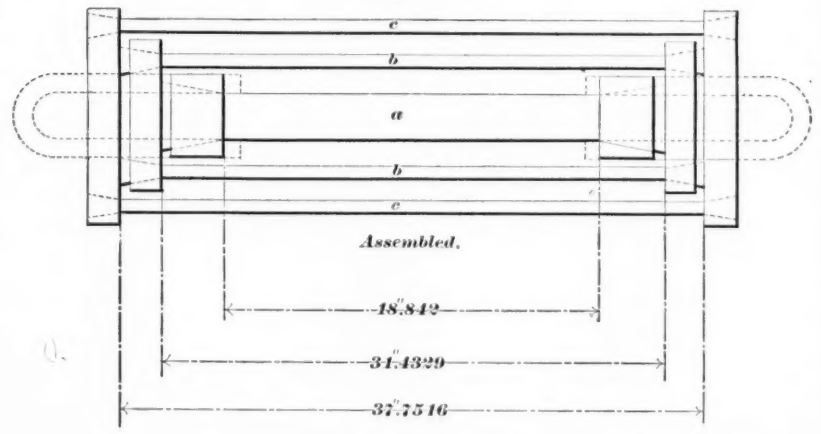


Fig. 2.



STRESS IN CYLINDERS.

from the interior with forgings by shrinking hoops over a tube.

Where accuracy of bore is required to be maintained, the elastic strength of the metal is taken as the base of the computations.

Assuming that a steel bar of one inch area, and 18.8496 inches long, offers the same resistance to a compressive as to a tensile stress if subjected to a compression of 22 tons, it will shorten

$$\frac{22 \times 18.8496}{14{,}000 \times 1} = .0296208 \text{ inch},$$

which is the greatest amount it can be shortened without destroying its elasticity, and giving it a permanent set.

If the bar is formed into a hoop whose inner circumference is equal to the above length the diameter would be reduced

$$\frac{.0296208}{3.1416} = .0094282 \text{ inch}.$$

The bar would extend an equal amount with the tensile application of the same stress; thus it would have a range of .038416 inch within its elastic limit.

The formulas and methods employed in the compound or built-up construction of cylinders are complex, and may be found in modern works on ordnance; the principles involved can be illustrated by a system of straight bars.

Let Fig. 2 represent such a system which it is proposed to build up, utilizing the increase of extension of the longer bars in giving them an initial tension. The area of bar a is two square inches; the combined area of $b\ b$ is one inch, and of $c\ c$ one inch. Subjected to their elastic strength of 22 tons per square inch they will extend as follows:

Ext. of $a = \frac{22 \times 2 \times 18.8496}{14{,}000 \times 2} = .0296208$in.

Ext. of $b = \frac{22 \times 31.416}{14{,}000 \times 1} = .049368$ in.

Ext. of $c = \frac{22 \times 37.6992}{14{,}000 \times 1} = .0592415$ in.

The difference in extension between a and b is .049368 — .0296208 = .0197472 inch. This difference can be utilized in giving to the bars b an initial tension. The stress required to produce this amount of extension is:

$$\frac{14{,}000 \times .0197472}{31.416} = 8.8 \text{ tons};$$

the bar a is required to sustain this pressure, and will be compressed or shortened by it.

The outside length of a, or that subject to compression, is 31.416 inches.

Assuming the same modulus for compression as for extension, the bar a will be shortened

$$\frac{8.8 \times 31.416}{14{,}000 \times 2} = .0098736 \text{ inch}.$$

The sum of the compression of a, and the initial extension of b, is what is termed the shrinkage; it amounts in this case to .0197472 + .0098736 = .0296208 inch, and which is to be added to the length of a, making it before assembling:

31.416 + .0296208 = 31.44562 inches long.

To assemble, the bars b are heated until the yokes connecting them will pass over bar a; they are then allowed to return to normal temperature, when the inside length of b will remain 31.416 + .0197472 = 31.43572 inches. The increase of temperature necessary for the expansion of bars b is:

$$\frac{.0296208}{.0000066 \times 31.44562} = 143^\circ \text{ Fahr.},$$

plus the necessary clearance. The difference in the extension of bars b and c is:

.0592415 — .049368 = .0098735 inch;

this difference is to be utilized in giving to bars c an initial tension which amounts to:

$$\frac{14{,}000 \times .0098735}{37.6992} = 3{,}668 \text{ tons}.$$

This amount will compress all the bars below it.

The compression will then be on 31.4357 long by three inches area, and on 37.6992 — 31.4357 = 6.2635 long by one inch area.

The amounts the 3.668 tons will compress respectively are:

$$\frac{3.668 \times 31.4357}{14{,}000 \times 3} = .00274536 \text{ inch},$$

and

$$\frac{3.668 \times 6.2635}{14{,}000 \times 1} = .001641 \text{ inch},$$

making a total compression of .00274536 + .001641 = .00438636 inch. The sum of this compression, and the difference in extension of b and c, which is

.0098735 + .00438636 = .0142598 inch,

is the shrinkage to be added to the length of the bars b, making their outside length before assembling

37.6992 + .0142598 = 37.7134598 inches.

The bars c are now to be heated until their yokes will pass over the parts already built up; on returning to normal temperature the bars c will remain extended to

37.6992 + .0098737 = 37.7090735 inches.

The system, as now assembled, and at normal temperature, is said to be in a state of rest.

If a force is applied to the heads of bar a, producing an outward stress, the system will be in a condition similar to a cylinder subjected to internal pressure. Let us examine the effect of such a stress, and develop the weak element which limits the strength of the structure. The difference in extension of the respective bars when at rest and under stress is for

a 18.8794 — 18.842 = .0372 inch,
b 31.4693 — 31.432 = .0364 inch,
c 37.7586 — 37.709 = .0496 inch.

The lengths of the heads of bar a are subject to compression, which we will assume they are free to do. The sum of these lengths is 31.4329 — 18.842 = 12.5909 inches. When the bars b and c are loaded to their full elastic capacity, which we will assume them to be, they will sustain a tension of 22 tons each. Then that part of a subject to compression will be shortened

$$\frac{22 + 22 \times 12.5909}{14{,}000 \times 2} = .01978 \text{ inch},$$

or reduced to

12.5909 — .01978 = 12.57112 inches.

The outside length of a, then, when extended to its elastic limit, is

18.8794 + 12.57112 = 31.4505 inches,

which is less than b is capable of extension by .0188 inch. Then a is the weak element, because it would reach the limit of extension first.

Railroad business is looking up materially. The moving of the crops has brought up the earnings until the dividends declared are generally satisfactory. Farmers are satisfied with the result of their year's product, and the business that goes out from this in the way of transportation will mean more machinery and cars next year. Every manufacturing interest in the country is dependent upon some other industry, one helping the rest along.

Some one has introduced a bill in the assembly at Albany which calls for more holidays. There is a question if the man who works by the day, and gets his pay for the day's work he does, does not already get about all the holidays his wages will stand. A day's wages out of the week's wages of a workingman makes a serious hole in the week's account.

Tools Marked to Indicate Both Their Places and Their Use—Can it be Used?—Points from Hartford.

BY JARNO.

Since my article of December 31, 1891, Waubug Mephit has written to me concerning the point from Hartford as to marking a tool to indicate the place where it is kept. "This point is more than ten years old in our shop; however, your article is good enough to help fill up the paper."

I was glad to note that, for once, Mephit gave his attention to what I wrote about, rather than find fault with how I wrote; because usually he hitches so long upon what he conceives to be mistakes in writing, that he does not reach the subject at all. I answered, "Send me an exact copy of the marks on one of your tools." He sends a copy, which is shown in Fig. 10.

I also sent to Hartford for a copy of tool marks, and received Fig. 11.

It is evident that Mephit has made a mistake in his letter to me, because Fig. 10 does not indicate the place where his "whip handle" gauge is kept. What he has really done in his shop is merely to mark places to show what tools are to be kept in them, which is not enough to enable a new man to go and find one of the places, after looking at the marks on a tool. In order to find a place for a tool in Mephit's shop, a new man must grope until he comes upon one that is marked like the tool to go in it, which may not be until he has gone through the shop from cellar to garret.

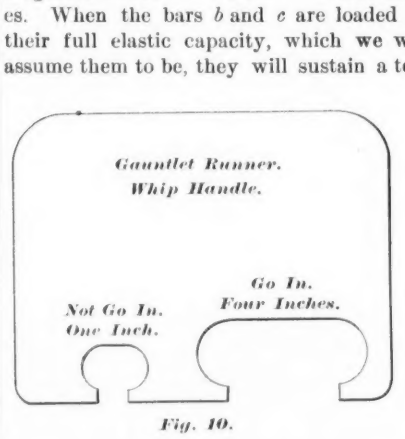


Fig. 10.

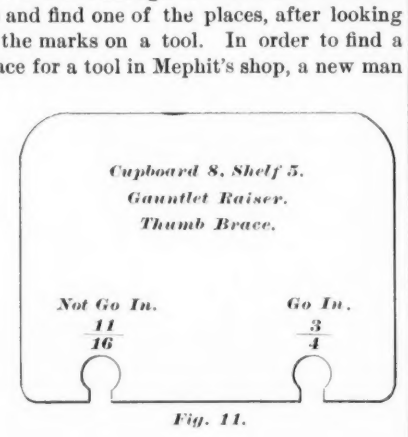


Fig. 11.

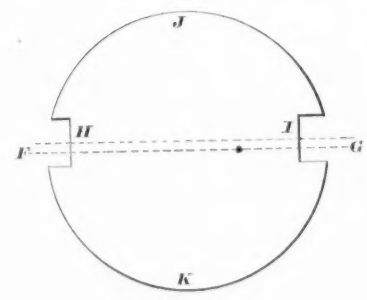


Fig. 12.

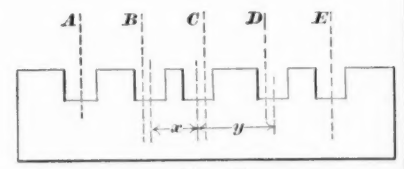


Fig. 13

TOOLS MARKED TO INDICATE BOTH THEIR PLACES AND THEIR USE.

Fig. 11 confirms my understanding of the Hartford system of marking; each tool has two kinds of marks—one kind to indicate where the tool is kept when not in use, the other kind to indicate what the tool does when in use. Now, the cupboards, or drawers, or whatever the tools are kept in, are marked upon some self-explaining system; both a cupboard and its shelves are numbered; the drawers are marked in tiers, and each drawer is numbered according to its place in a tier. Any one, even though a stranger in the shop, can find the place where a tool belongs, after seeing its marks, the same as one can find any street and number in the part of a city that has streets named upon a self-explaining system. I am forced to conclude that the Hartford system is worthy of "imitation."

My Hartford friend's letter goes on:

"By this time, Jarno, doubtless you have wondered whether friction hardening can be put to any useful purpose. Though oftentimes quickly done, yet there seems to be too much uncertainty about it, to depend upon it if wanted; but, if we are not careful, we may depend upon it when we don't want it. So far as I have heard, the only satisfaction we are likely to have, in connection with a knowledge of friction hardening, is that of knowing that it has been avoided. This is about as consoling as the saying of my good mother, 'You ought to be thankful that it is no worse'—a consolation that failed upon me when I fell from a ladder and broke an arm.

"I find that this friction hardening is much more common than I supposed. It is a thing limiting production in some grinding operations in soft steel; the skill of the workman being constantly tasked to keep up production and at the same time to avoid friction hardening.

"Inaccuracies in spacing may be exaggerated in measuring. Errors in the spacing of a circle and in the spacing of a straight line may, in comparing one space with another, be multiplied four times; that is, the difference between the lengths of two spaces may be four times as long as the actual error in the spacing. In Fig. 12 let $F\ G$ be a line that divides a circle into two equal parts. Now, let the spaces H and I be out of position, each a thousandth of an inch from $F\ G$, in the direction toward J; then will the distance $H\ K\ I$ be four one-thousandths longer than $H\ J\ I$. As another example: In the piece, Fig. 13, let the spaces between the lines A to E inclusive be each a half-inch in length. The grooves A and E are in the right position, being central with the lines. The grooves B, C, D, are each only a sixteenth out, and yet the distance y, between the grooves C and D, is a quarter inch longer than x between B and C."

LETTERS FROM PRACTICAL MEN.

Lathe Carriage Hand Wheels.

Editor American Machinist:

I wish to go on record with my solemn protest "again" your answer to S. T. W.'s second question, on page 9 of your issue of January 7th. You say, "In small and medium size lathes we prefer to work the feed handle of the carriage by the left hand; in large lathes by the right hand." Now you don't "prefer" to do anything of the kind. If you did you wouldn't stay up in your sanctum at 96 Fulton street. There are but a very few makers of lathes that put the feed handle on the right side, and they do it because their fathers and grandfathers did it before them; their ancestors did it when gap lathes came in fashion because they could not get the carriage up close to the head-stock when not using the gap, and by altering to the right side one style of carriage answered for the two types of lathe.

The handle has no business to be on the right side whatever. I received my first lessons on a lathe of that type, and I vividly remember now what a time I had trying to find the handle after I got into a shop where the handles were all on the left side, and I also recall the satisfaction I took in that handle after I had got used to it on the left side. So easy to rest your elbow on the carriage and look right in the hole you are boring, don't you know? W. S. ROGERS.

[This is a matter about which we do not expect that machinists will ever be entirely agreed. And moreover we do not think that it is necessary that they should agree upon it. There are three prominent establishments at least in this country that put the carriage hand wheel or crank handle at the right, and we believe they do it, not for the reasons given by Mr. Rogers, but for other reasons which appear sufficient to them. There are many working machinists who sustain their views in this matter. Like all other machinists, we have our views on the matter, though, to tell the truth, an entire unanimity of opinion on the question will not be found even within this office.—ED.]

Proportion in Steam Engines.

Editor American Machinist:

In October an article appeared from the writer's pen under the above caption, in which I stated some facts occurring under my observation in years past, going to prove that the former long stroke piston and small diameter of cylinder had been improved by an increased diameter of cylinder in proportion to length of stroke of piston in later years. Now what I stated as a

principle occurring in the cases I referred to has also occurred in the case of *every* railroad building new engines, or locomotive shops or stationary engine builders, namely, this: as greater demands have been made of the steam engine, all builders have modified more or less towards the principle I therein advocated; and I know of no instance where the long stroke and small cylinder has been modified to a longer stroke and a smaller diameter of cylinder; but, on the other hand, better results have been obtained in all steam engines, due in part to larger diameters of cylinders in proportion to stroke. Your correspondent in December 3, Mr. C. O. Sine, objects to the principle stated, and says I am prejudiced in favor of short stroke engines; if I am, facts make me so, covering years of experience and close observation; and possibly he may have undue prejudice for the long stroke engine for an opposite reason; I will not say that is so, as I do not know him, nor would I cast any reflection on any man, be he more or less informed than I am, as all know little enough, I am sure.

He refers me to the record of the Corliss engine as proof; of what, he does not tell, for the simple reason that he does not state to us any facts of a long stroke Corliss engine in competition with some other make of engine equal to it in other respects, but having less stroke of piston but greater diameter of cylinder; and I was not aware that in the record of the Corliss engine builders that they had reduced the diameter of their cylinders and lengthened the stroke of the same, so that their record is no demonstration of the comparison of the value of long or short stroke engines, unless they have changed from one to the other; I will say this, however, that in the present construction of compound expansion engine constructed by the Corliss Co. the second cylinder in diameter is nearly equal in inches to the length of stroke. Why? Oh, because it works better! Exactly so. Why not try the experiment on the first cylinder? The principle holds as good, I claim, in one as the other.

Mr. Sine calls attention to the fact that the latest and fastest locomotives have 24 inches stroke; but he did not tell us what the diameter of the cylinder was—probably not less than 18 or 19 inches. I suppose he would have preferred the 16x26″, as he argues in its favor. And he tells us that the heaviest locomotive has 28 inches stroke, but does not tell us that the diameter of the cylinder is about 22 or 24 inches. Why did he not give us both? Probably because he is "*prejudiced*" in favor of long stroke! Let me correct an error he committed in telling us without qualification that the traction of a 60 inch wheel and a 68 inch wheel under the same weight is the same. It is a well-known fact that the smaller wheel will hold on to the rail better than the larger one, hence he will observe that heavy freight locomotives are always mounted on small wheels. Why? Because long years of experience has taught builders and users of locomotives that they will pull the most, by considerable, with the same diameter of cylinder and length of stroke; but modify the cylinders and cranks and a difference occurs. Simple traction produced by gravitation is one thing, and alone is slightly in favor of the 68 inch wheel, as its periphery is larger than the 60-inch wheel, technically speaking; but I am "prejudiced" slightly otherwise, and allow the difference to be only slight either way. But when we attach power to wheels on rails under weight it makes some difference what the diameter of cylinder is, and the length of stroke is that is attached to them as to traction. Now I will make this point clear by a reference to former cases. Years ago a certain railroad built a large number of what were called 30-ton freight engines, 16x26-inch cylinders; they were *the* freight engine of the road for years; they had two pairs of 60-inch drivers connected in the ordinary American style. In time—as I stated in my former article—it became necessary to build passenger engines of more power, and as an experiment one was built 18x22″, with about a 68 inch wheel weighing about 30 tons also; the trial trips proved it to be more efficient than the 16x26″ cylinder with a 60 inch wheel engine was, so that that freight engine was modified to have less stroke and greater diameter of cylinder.

Here is the efficiency of three types of 30-ton engines having about the same weight on their drivers, but cylinders and wheels somewhat varying. The work performed was drawing trains up a 60-foot-to-the-mile grade.

First—Cylinder, 16″ diameter; piston, 26″ stroke; 2 pair wheels, 60″ diameter. Load, 300 tons.

Second—Cylinder, 18″ diameter; piston, 22″ stroke; 2 pair wheels, 68″ diameter. Load, 380 tons.

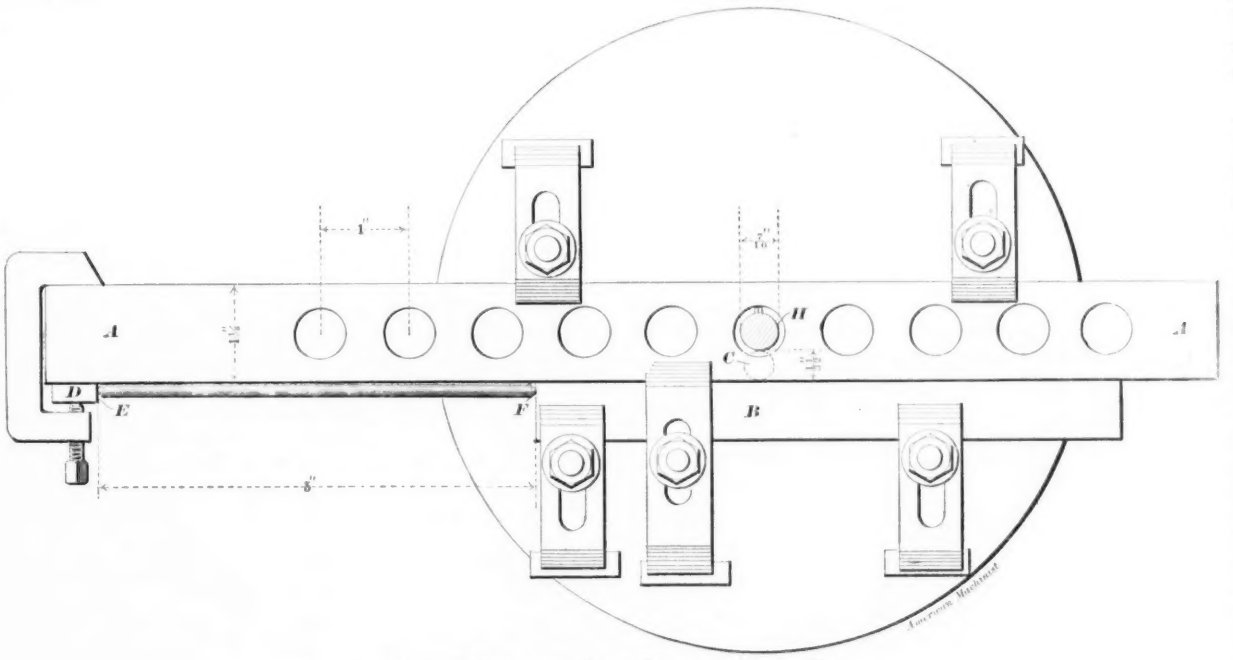
Third—Cylinders, 18″ diameter; piston, 22″ stroke; 2 pair wheels, 60″ diameter. Load, 450 tons.

When wheels are smaller in diameter, and powerful piston rods are attached to them by a proper length of crank, the traction of wheel on the rail is aided at least by a part of each stroke by the same power which serves to turn the wheel. If you doubt this action, observe the action of the cylinders of any "center bearing" forward truck engine commonly known as an 8-wheel engine, that the forward part of an engine lifts to one side alternately at each stroke, and that lift is on the crank towards the rail, as it were, adding from the front of engine, *via* an angle, some traction to what is there already, *via* gravitation (*i. e.*, on the drivers). But I must add a bit of further testimony also occurring under my observation while employed by the self-same railway. As I stated before, they built a passenger engine 18″x22″ cylinder by 68″ wheel, and it did good service; others were built of the same proportions, and did well also. But they also bought six new first class passenger locomotives from a first-class firm in New Jersey which were heavier on the drivers (than the company's engines were), having cylinders 16x24″, with a 68-inch wheel. They were intended to do better service than the railway company's did, but they never did as well, so far as pulling up the grade was concerned. The 18x22″ cylinder with 68 inch wheel would pull the load "up the hill" the quickest by "quite a bit," though the new machines were some the heaviest on the drivers. Every effort was aided to make the new shining machines excel, but that two inches larger diameter of cylinder with some less stroke and weight did more business than the longer stroke did. Catch on to the point, you long-stroke men? I made a prophecy as soon as I knew the size of the new machines, that the 18 inch cylinder 22-inch stroke would win the day against the 16-inch cylinder with 24 inch stroke, every time; and subsequent use proved it true. The company's engine had only 12-inch ports, while the new engines had 16-inch ports. How about power and traction? Mr. Sine speaks of indicator cards; that is all well in its place, but we practical men, as well as railway stockholders, are interested in indicator cards, which show that *some of the coal* burnt did good service, as well as some other things pleasant to speak of—coal bills. But I am some surprised when Mr. Sine speaks of speed of piston as of little account; it certainly is an item of consideration when we remember two things: first, the less the piston "travels" the less it wears; second, the shorter the crank the less power required to arrest and restart main connecting and parallel rods; and it has become quite an item in the present 24-inch stroke passenger engines as to the best form of rod to prevent vibration, and have them as light as is possible.

Gentlemen of the long stroke order, shorten up to 22 inches or less, and you will have less trouble, though you turn your wheels faster and enlarge cylinders. I have only touched on this pleasant subject; my observation covers time from the drop and V-hooks to the present, with lots of interesting incidents on this question.

"All aboard" or "get left" in every genuine advancement of mechanical progress. I hope none will misunderstand my claims.

FRANCIS W. CLOUGH.



GOOD WORK AND GOOD WAYS OF DOING IT.

Good Work and Good Ways of Doing It.

BY A MECHANIC.

I will try to show in this a good way to bore a number of holes on a straight line, accurately spaced and accurately in line. This is usually thought to be a hard thing to do, but, like most everything else, it makes a great difference *how* it is done.

Of course there are simpler ways of working where accuracy is not required, but where accuracy to within .001″ is required I believe this is a good scheme.

A in the inclosed sketch represents the face of work to be bored. I have shown this with ten holes to be bored just one inch apart. We will suppose that the piece *A* is too long to swing in any lathe, so a drill press is used.

First lay out the holes on the work in the usual way, and drill a little smaller than the finish size, to allow for reboring; then clamp a parallel to the drill press table, as shown at *B*, and set it the right distance from the boring bar *H* by using a plug, in diameter one-half width of work less one-half diameter of boring bar, as shown in dotted circle at *C*. Now clamp the work to the table, in contact with the parallel as shown.

Set the work in position to bore the first hole, and clamp the block *D* to work as shown, having the edge *E* in contact with the square end of parallel *F*.

Then, after boring the first hole, use a 1″ plug, or end measure, and with it set the distance right between points *E* and *F*, which, of course, is the same as the distance between centers of holes in work. After boring the second hole use a 2″ end measure, and set the same for the third hole, and so on for all the rest, but always measuring from the same points, so as not to multiply errors.

A friend was telling me a short time ago of a scheme he tried for drilling an original index plate, where he used a jig with two holes in its outer end, to correspond with one space of the circle of holes required, and its inner end pivoted to the center of plate to be drilled.

He drilled the two holes in jig about as good as he could, and, after drilling the first two in plate to correspond, he fitted a plug to one of the holes and then moved the jig one hole ahead and inserted the plug, which held the jig in position for drilling the next hole, and so on all around. When he got back to his starting point he found that he had almost room for an extra hole. Good big measure, of course, is to be desired in some cases, but in this one he would have been satisfied if he had got just even measure.

I should bore these holes with a single-pointed cutter. The reasons why I should prefer a single-pointed cutter instead of a double-pointed one are these: The pressure upon a single-pointed cutter always keeps the bar and machine spindle well seated in the opposite side of its bearings, and so takes up all looseness; where, if a double-pointed cutter is used, the spindle and bar are balanced in their bearings, and then whatever looseness there is is brought to light in the way of inaccurate work. Then there is the spring of the bar to contend with; when there is much more stock upon one side of the hole than upon the other, a double-pointed cutter will cut out stock where it should not, for the amount that one end of the cutter springs away from the high side will be cut out of the slack side, and of course this does not true the hole. A double-pointed cutter, of course, has advantages for some kinds of work, but it is not good to true a hole.

Mr. John Conkling was delegated by the immigration authorities to look into the interests of the miners in the Pennsylvania coal regions. It appears that he has found that English-speaking miners are scarcely employed at all, as they were a few years ago, but in their place are men who never propose to become American citizens, and do not want to learn the English language. It is not contended that these men are law-abiding, or even decent, but they work for little money, spend but a small part of their wages in the country, and, after accumulating a few hundred dollars, go home with it. Inspector Conkling concludes that the law prohibiting the importation of laborers is persistently evaded, and that more stringent measures should be employed for its enforcement.

Not long since a man was caught in an effort to wreck a train on the Rome, Watertown & Ogdensburg Railroad, and it was with considerable difficulty that the passengers were prevented from lynching him. This is a case where, possibly, prevention was a mistake.

AMERICAN MACHINIST

Communications relating to the reading columns should be addressed to the Editor. All other communications should be addressed:

AMERICAN MACHINIST,
96 FULTON ST., NEW YORK.

PUBLISHED WEEKLY AT
96 Fulton Street, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
J. G. A. MEYER, } Associates.
FRED J. MILLER, }

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$3.00 a year in advance, postage prepaid, in the United States, Canada, and Mexico.
$4.00 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
DEALERS SUPPLIED BY
The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Buffalo News Co., Buffalo, N. Y.
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Subscriptions received in Paris, France, by E. TERQUEM, 31 Boulevard Hausmann, at 20 francs per annum, postpaid.

Subscriptions received in Australia by W. WILLIAMS, 17 and 21 Fink's Buildings, Melbourne,

NEW YORK, FEBRUARY 4, 1892

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Boiler Explosions.

We have received, of late, an unusually large number of accounts of boiler explosions. These accounts are, in the main, extracts from local newspapers, and cannot be relied upon beyond the statement of the fact that so many were killed or injured by the occurrence.

We have previously expressed the opinion that there was no occasion for boiler explosions if boilers were under the supervision of competent men. By competent men we mean men who can detect signs of weakness, and let their voice be heard in the matter.

Boilers are made by reputable manufacturers with a large factor of safety; but, like everything else, they will wear out. Then it is that the skill of the engineer comes into play. The very fact that a boiler is made oversafe—to coin an expression—leads to a belief that it will always be safe. As a matter of fact, it may not be safe for two years. Its strength is in its weakest point, and its quality in this respect must be determined by the examination of a man skilled in such matters.

A steam boiler is not only subject to corrosive action, but it is subject to a bending of the material first one way then another, as the pressure is increased or decreased. This last-named cause may not amount to much, but it undoubtedly has its effect in the way of helping along the weakness of parts.

The skilled engineer watches his boiler when under pressure, and when there is no pressure on it; and while he could not probably formulate rules in the matter, he sees danger from afar. A doctor or a lawyer must be trained to his business. There is, especially in view of the increased number of boiler explosions, as good reason why the engineer should be trained to his business before he is allowed to have charge of a boiler. Looking at the matter just as it is—anybody who will accept low wages allowed to have charge of steam boilers—the wonder is not that so many explosions occur, but that more do not occur.

There is no remedy for boiler explosions except that the men who manage them shall be subjected to an examination as to their fitness to perform their duties, just the same as a doctor or a lawyer is. In either case, it is the jeopardizing of life and property of others that is to be mainly considered.

We believe, fully, in a law that shall not permit an engineer to have charge of boilers unless he has a license from some competent jurisdiction. It is not necessary that he know anything about the classics, but he should be able to explain something about the management and care of a steam boiler. We have faith to believe that the time will come when this will be required; but good things come at a slow pace.

The Machine and the Method.

We continue to hear occasional accounts of very minute engines or other pieces of machinery that have been constructed, usually by some obscure person, who is thereupon immediately lauded as one of the most remarkable and ingenious mechanics that ever lived.

It is not true that the construction of an engine and boiler which will stand upon a silver dime, and can be covered by a lady's thimble, proves the maker to be a good mechanic. It may not only be true that such an engine builder is not a good mechanic, but it may be further true that he is constitutionally incapable of becoming a good mechanic. Some of the attributes of a good mechanic, *i. e.*, a certain degree of skill of the hands, and patience, are shown by such a structure, but a man may have these and yet be very far from a really good mechanic.

In the present state of the mechanic arts it is really less the completed job of work that reveals the true mechanic than the methods pursued in doing the job. It is quite possible for two machines, large or small, to be built practically just alike, or so nearly alike that inspection and use fails to reveal any difference between them, and yet one may be built by a first-class mechanic and the other by a very poor one. There will, however, be a difference in the cost of the machines, simply because the one will be built by the best methods attainable, while the other may be built by about the worst and most expensive.

It is just here that the fond parents of supposedly precocious youngsters attending trade or manual training schools often make a mistake. Because a boy of fifteen years constructs an engine that is bright and will run, they often conclude that its youthful builder is a phenomenon, and has learned by a few hours' instruction what ordinary mechanics require years to master. Yet in most cases there will be hardly a single piece of the engine that has been made as a good mechanic would make it, and the chances are that its builder could not go into a machine shop and properly center a piece of work or perform in a proper manner any one of the simplest every-day operations that machinists have to do.

Though there may not be any great difference between the completed machine of an amateur and that of a regular machinist, there is a vast difference between the puttering methods of the amateur and the well considered, logical, experience-guided methods of the genuine workman, and this difference is sure to make itself manifest in the comparative cost, if in no other way. It is not so much in what a man builds as in how he builds it.

Naval Service.

Some one who signs himself "Fair Play" has been writing a series of articles for the New York *Times*, in which he has been making quite plain the reasons for the difficulty experienced in getting and retaining good men in some of the departments of our navy.

He shows plainly that the whole tendency in the navy is to magnify the machine and officers and to degrade the men. Among other facts the following are given:

Forty-three per cent. of the enlisted men in the navy are citizens of foreign countries; 37 per cent. have made no attempt to become naturalized; 17 per cent. declare their residence to be in foreign countries. As proof that there is "no career for seamen" in the United States Navy—at least for American seamen—it is sufficient to state that 1,388 men deserted last year—17 per cent. of the whole force; 694 American apprentices were enlisted last year, but 319 deserted and 330 took their discharge, so that the navy gained just 45 American apprentices in one year—a fair illustration of the feeling the American lad has for the naval service of his country, a measure of its attractiveness as a "career."

It is the men who maintain this condition of affairs that are supposed to rule over the machinists and engineers that are becoming more and more necessary on board the modern floating fighting machine known as a naval vessel. Is it any wonder that good mechanics who can find anything to do ashore refuse to remain in a service in which ordinary unskilled men cannot be retained?

It is beginning to be quite apparent that a considerable revolution will have to take place in naval customs and usages sooner or later, and the sooner it takes place the better.

The Cry of Wolf.

The Chicago police are shown up in a very bad light by recent revelations concerning their dramatic, not to say outrageous, interference with private rights in forcing their way into assemblages of workingmen and compelling them to display American flags in their meeting. It has been stated, and corroborated by reliable citizens, that this was done solely to induce a renewal of $100,000 annual subscriptions from wealthy citizens of Chicago for the "suppression of anarchy," subscriptions which had been paid for several years, but which the subscribers to had begun to have doubts as to the propriety or necessity of.

It is beginning to dawn upon the minds of many people that there has been and is now far less anarchy in Chicago than the police of that town would like to have believed, and that there would be far less of it if it were not for the idiotic performances of some of the police themselves.

It should always be remembered that when a policeman or a Pinkerton guard exceeds his lawful authority and violates private rights, he becomes by practice, if not in theory, an anarchist himself.

A valued correspondent writes us to the effect that he has invented a new tool that can be made for a small sum of money, and he thinks if offered as a sort of "prize package" with the AMERICAN MACHINIST, it would, as he puts it, "boom" our circulation. If our correspondent has invented something new and useful, our columns are open to him for the purpose of letting the world know what he has, but we are not in the way of giving premiums to subscribers, nor is it likely we ever shall be. We propose to make every number worth the moderate price asked for it, and have no occasion to find fault with the outcome of this way of dealing with our readers. At the same time we appreciate the kindly feelings which have led our correspondent to propose this plan.

In reply to Mr. H. L. Reynolds, who inquires in our issue of January 21st for a spraying device, Mr. R. G. Du Bois, Washington, D. C., writes to say that a patent was granted twelve or fourteen years ago to Smith & Messenger for a spraying device in which compressed air was used. There are, he says, in hydro-carbon burners many devices for atomizing fluids. Mr. Du Bois offers to willingly give any other information he may have within his reach.

Literary Notes.

Mr. John Richards' *Industry* comes to us this month in magazine form, with pages the same size as the other magazines, and comparing very favorably with them in all respects, so far as the limitations of a mechanical or engineering journal will permit. Its editor is a man of very large acquaintance with mechanical engineering, and with original ideas which he does not hesitate to express upon proper occasion. He is doing a good work for mechanics with his magazine, and we wish him continued success. It is devoted more particularly to the Pacific coast interests, and is published by the Industrial Publishing Co., San Francisco, Cal.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(46) E. F. D., Massillon, O., asks: Are there any standard sizes for pipe flanges from one inch upwards? *A.*—No.

(47) J. W. P., Jeanesville, Pa., asks: Which is a good work on the construction of jet and surface condensers? *A.*—Manual of Marine Engineering, by A. E. Seaton, is a good book.

(48) H. S. S., Kilbourne, O., writes: I want to make an ejector to fill tanks on a traction engine. I have 20 feet of 2¼-inch hose. Please give me the diameter of steam pipe and delivery pipe. *A.*—Diameter of steam pipe, ¾ inch; diameter of delivery pipe, 1¼ inch.

(49) W. T., ———, writes: Is there a metal sensitive enough to control a damper on a incubator by contraction and expansion? If so, will you be kind enough to name it. *A.*—Copper is the most sensitive of the common metals, and a thin strip of it might be used and its motion multiplied by a lever if necessary. Strips composed of two different metals soldered together are sometimes used. The two metals expanding differently

cause the strip to deflect more or less, and from the resulting motion the damper may be controlled.

(50) J. R., Galesville, Wis., writes: Kindly give me through your columns the size of steam and exhaust ports, width of bridge, size of slide valve, and its travel, for 5½x8-inch cylinder; the engine is to run at a speed of 300 revolutions per minute. *A.*—Size of steam ports, ½x4 inches; exhaust port, 1x4 inches; lap of valve, ⅝ inch; width of bridge, ½ inch; travel of valve, 2½ inches.

(51) J. C. G., ———, asks: Can you tell me of any liquid of about the same specific gravity as glycerine that will not change gravity or thicken in cold weather? I do not care what it is, so long as I can hold it in an iron cylinder. Have tried mercury, but cannot hold it. *A.*—We do not know of any liquid that would fill the requirements. Perhaps some of our readers know of something.

(52) R. H., Brooklyn, N. Y., writes: Kindly give through your columns a little light on the following: Are all men who affix M. E. to their names college graduates? *A.*—No. 2. What is the longest and shortest term for that degree? *A.*—From two to three years. 3. Name a few of the best colleges to study mechanical engineering in. *A.*—We cannot undertake to do so. The progress of the student will depend much on his own energy and attention to his studies. Sometimes good institutions are unjustly blamed for the failure of a student in becoming an engineer.

(53) E. M., Amherst, Mass., writes: I wish to build a 2 horse-power gas engine with three single-acting cylinders, all connected to one crank. What should be the diameter of cylinders, stroke of piston, and thickness of metal in cylinders? I wish to make it as light as possible. *A.*—Your question is very indefinite. Our advice is, do not attempt to build one unless you are familiar with this class of engines, and can make a drawing of it before you commence to build one. We always take pleasure to answer questions, but we cannot undertake to design machinery for our friends, as our time is limited. We would not attempt to answer your question unless we made a drawing of the cylinders, placed in their correct position, so as to be sure that the connecting rods will not strike the cylinders; this involves considerable labor for which we have no time.

(54) J. D., Bluefield, W. Va., writes: I have a looking-glass which has been scratched and the quicksilver needs replacing. I wish to know what articles to use so that I may replace this quicksilver myself. *A.*—The repairing of the silvering on the backs of looking-glasses is considered to be a difficult operation. The following method, comparatively simple, is recommended: Clean the bare portion of the glass by rubbing it gently with fine cotton, taking care to remove any trace of dust and grease. If this cleaning is not done very carefully, defects will appear around the place repaired. With the point of a knife cut upon the back of another looking-glass around a portion of the silvering of the required form, but a little larger. Upon it place a small drop of mercury; a drop the size of a pinhead will be sufficient for a surface about ½ inch square. The mercury spreads immediately, penetrates the amalgam to where it was cut off with the knife, and the required piece may now be lifted and removed to the place to be repaired. This is the most difficult part of the operation. Then press lightly the renewed portion with cotton; it hardens almost immediately, and the glass presents the same appearance as a new one.

(55) A. D., New York, writes: Please give me your opinion of a boiler of which I inclose a sketch. It consists of a body made of a piece of 14-inch pipe 22 inches long, with 26 tubes 1½ inch diameter expanded into the heads. There are two rows of 15 holes each, one inch diameter, tapped with left hand threads; one row is situated near the bottom of the body, and the other row at the water line. Below the grate there is a piece of 3 inch heavy pipe, bent to a circular form, with heads welded in; the distance between the ends is equal to the width of the ash pan. In the top of this pipe there are 25 holes, 1 inch diameter, with right-hand threads. Vertical pipes are screwed into these holes and extend to the two rows of holes in the body. The five pipes over the furnace door do not connect with the bottom pipe. There will be a band of 1½x⅜-inch iron bent around the bottom of the 1-inch vertical pipes, to prevent the 3-inch pipe from expanding. The grate is 12 inches below the body. The hole is to be covered with sheet-iron and asbestos. *A.*—The row of holes in the top of the 3-inch pipe will weaken the latter to a dangerous extent. Although the boiler may steam well, it is an expensive one to build and costly to keep in repair. We prefer a well-designed ordinary upright boiler.

(56) A. K., Chicago, Ill., writes: What stress will there be in the branches *A B* and *A C* in a boiler brace (Fig. 1) supporting a surface 12 inches by 6 inches, the steam pressure being 100 pounds per square inch? How is this stress determined, and what will be the stress in the rivets *R R*? *A.*—The total pressure which the brace has to resist is equal to $12 \times 6 \times 100 = 7{,}200$ pounds. Let *C B*, Fig. 2, represent the boiler plate, part of which the brace has to support. Draw a line *a d* perpendicular to *C B*, and make it any definite length, say 1½ inch; this line will represent the total pressure (7,200 pounds) which the brace has to resist. Through *a* draw *a b* and *a c* parallel respectively to *A B* and *A C* in Fig. 1, which represent the center lines of branches of the brace. Through *d* draw *d b* parallel to *A C*, meeting *a b* in *b;* again through *d* draw *d c* parallel to *A B*, meeting *a c* in *c*, and thus complete the parallelogram *a b c d*. Now the stress in *a b* will be as much smaller than the pressure represented by *a d* as *a b* is shorter than *a d*. If now *a d* measures 1½ inch and *a b* $\frac{7}{10}$ inch, then the stress in *a b* is found by the following proportion:

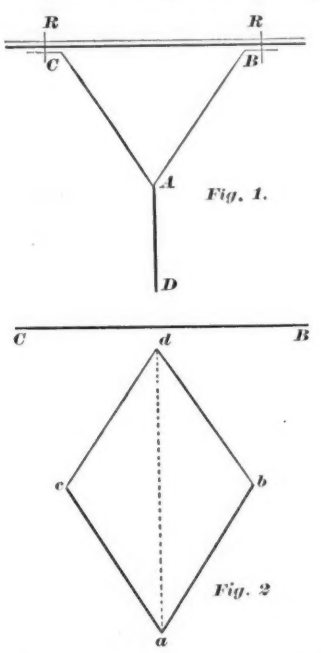


Fig. 1. Fig. 2

1.5 : .7 : : 7,200 : stress in *a b*, from which we get

$$\frac{7{,}200 \times .7}{1.5} = 3{,}360 \text{ pounds for the stress}$$

in *a b* or *c a*. The stress in *A D*, Fig. 1, will be 7,200 pounds, and the tensile stress in each rivet will be equal to $\frac{7{,}200}{2} = 3{,}600$ pounds.

(57) H. V. C., Denver, Colo., writes: In answer to a question in your issue of December 3, 1891, you gave a rule for calculating the horse-power of shafting.

$$\left(\text{H. P.} = \frac{D^3 \times R}{125}\right).$$

What I wish to know is, will the constant 125 be correct for cold-rolled shafting? *A.*—Messrs. Johnes & Laughlins, manufacturers of steel, iron, patent cold-rolled shafting, etc., of Pittsburgh, Pa., give the following rules, in all of which *D* denotes the diameter of shaft in inches; *R* revolutions per minute; *H* horse-power. For head shafts supported by bearings close to each side of the main pulley or gear, so as to wholly guard against the transverse strain, the following formula affords ample margin of strength:

COLD-ROLLED IRON.	TURNED IRON.
$H = \frac{D^3 \times R}{75}$	$H = \frac{D^3 \times R}{125}$
$D = \sqrt[3]{\frac{75 \times H}{R}}$	$D = \sqrt[3]{\frac{125 \times H}{R}}$

For line shafting from which power is taken at intervals—bearings 8 feet apart:

COLD ROLLED IRON.	TURNED IRON.
$H = \frac{D^3 \times R}{50}$	$H = \frac{D \times R}{90}$
$D = \sqrt[3]{\frac{50 \times H}{R}}$	$D = \sqrt[3]{\frac{90 \times H}{R}}$

For simply transmitting power and short counters:

COLD ROLLED IRON.	TURNED IRON.
$H = \frac{D^3 \times R}{30}$	$H = \frac{D^3 \times R}{50}$
$D = \sqrt[3]{\frac{30 \times H}{R}}$	$D = \sqrt[3]{\frac{50 \times H}{R}}$

Some engineers (especially in cotton mill practice) require from shafting much greater duty than the foregoing formulas give. Under favorable conditions this is admissible, but for ordinary practice it is believed that the sizes obtained by the formulas are as light as should be used.

(58) W. B., Danbury, Conn., writes: What would be the best kind and size of rope, not wire cable, for transmitting 1½ horse-power, distance about 35 to 40 feet? *A.*—We should use manila rope. The size of the rope for transmitting a given horse-power will depend on its velocity, which you have not given. For a speed of 1,500 feet per minute a rope ½ inch diameter will transmit 1.45 horse-power; at 2,000 feet per minute it will transmit 1.9 horse-power. 2. Could hook and eye fastening be used? *A.*—No. 3. Will there be much shrinkage and stretching? And is there any preparation that could be used to prevent wear, shrinkage and stretching? *A.*—In bending a rope over a sheave, the strands and the yarns of these strands slide a small distance upon each other, causing friction, and wear the rope internally. Open a worn-out rope by untwisting the strands and a fine powder will be found, showing that, when the rope was bent over the sheave, the strands, in sliding on each other, ground some of the fibers to powder. To obviate this difficulty C. W. Hunt Company, of New York, have the rope made by lubricating the fibers with plumbago mixed with sufficient tallow to hold in position. This lubricates the yarns of the rope and prevents internal chafing and wear. It lodges in the hollows and uneven places of the fibers, and lubricates the threads of the rope. The tallow makes this rope partially waterproof. After running a short time, the exterior of the rope gets compressed and coated with the lubricant, so that it looks, when running, like a rod of iron. In this condition it resists the ordinary rains to a great extent. A certain amount of twist comes out of the rope, and that will lengthen it in using it the first day or two, but after that the rope should remain substantially the same. If it does not, the load is too great for the durability of the rope. The size of the pulleys has an important effect on the wear of the rope; the larger the sheaves the less the fibers of the rope slide on each other, and consequently there is less internal wear of the rope. The pulleys should not be less than forty times the diameter of the rope for economical wear, and as much larger as it is possible to make them. This rule applies also to the idle and tension pulleys. The sides of the grooves should be carefully polished, as the fibers of the rope rubbing on the metal as it comes from the lathe tool will gradually break, fiber by fiber. It is also necessary to avoid all sand or blow holes, as they will cut the rope.

(59) J. T. W., ——, writes: I have read carefully and studied considerably the articles in the AMERICAN MACHINIST in regard to the new method of manufacturing fuel gas used by the American Gas Furnace Co. of your city. Your articles say that the blower delivers air at a pressure of only one pound, and that the expanding air and atomized oil produce enough cold (or absorb enough heat) to freeze the moisture which is held in the air. I cannot understand how one pound can produce such a temperature, especially when I saw nothing that led me to believe that the air was cooled in any way after it was compressed. If this low temperature is produced I cannot see why it does not collect on the perforated plates and stop them up. *A.*—The proportioning of the sizes of the holes in the various perforated plates, so that they would not be filled up by ice, and yet so that they would perform the functions required of them, has been one of the problems connected with the machine. They did fill up at first, but the difficulty was overcome by experimenting. We do not think we said that the blower delivered air at one pound pressure, but that the combination of air and oil vapor took place at a pressure not lower than one pound. There is considerable difference between the two statements, because the pressure is materially reduced after passing through the various perforated plates. However, the original air pressure is by no means high, and the low temperature results mainly from the volatile character of the oil employed. If J. T. W. will take some oil of .71 gravity and drop it several feet through the air, he will find that it has a pretty low temperature at the bottom of the fall. 2. What per cent. of the actual energy of coal is claimed by a steam plant of highest efficiency? I mean what is the total per cent. of loss in converting the total energy of the coal into useful work derived from the engine shaft? Please state also how this loss is divided, *i. e.*, how much is lost by the boiler and how much by the engine, approximately? *A.*—Under quite favorable conditions 10 per cent. of the total heat in the coal may be utilized in the engine. A fairly good boiler will utilize 65 per cent. of the fuel, so you will readily see that the greater part of the heat is lost in the engine—going to the atmosphere or to the condenser. You will never understand this matter until you study works on steam engineering—not merely read them, but study them.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's new 1892 Gear Book. See page 20.

Link-Belting and Sprocket Wheels.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link Belt in use.

Link Belt Engineering Co., Philadelphia and N.Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

See Gage advertisement below.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

"The Bulldozer," a new departure; forging by pressure. M'f'd by Williams, White & Co., Moline, Ill.

Gage Tool Co.'s Self Setting Plane does more and better work in less time. On trial. Vineland, N. J.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Our Automatic Gear Cutting Machine will increase production 50%. The Superior Mach. Wks., Clev'd, O.

$13.00 I Dea L. Drawing Stands. The original. Send for postal. W. S. Rogers, Troy, N. Y.

S. A. Smith, 23 South Canal Street, Chicago, Ill. agent for Holbrook's Raw Hide Blanks for Gears.

Save small iron from foundry refuse. It pays Use the Woodruff Pat. Separating Machine, Audubon Machine Works, New Haven, Conn.

"Roper's Hand-books for Engineers and Firemen." Descriptive Catalogue mailed free to any address. Edw. Meeks, Pub., 1012 Walnut St., Phila., Pa.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker St., Philadelphia, Pa.

S. W. Card & Co., Mansfield, Mass., make everything in the line of Taps and Dies. S. A. Smith, 23 S. Canal St., Chicago, Western Agent.

For best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th St., N.Y. Send for des'n.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson St., Chicago, Ill.

A Bargain—One 48x36-inch iron pulley, weight, 1 ton; two sets of arms; good as new. W. P. Davis, Rochester, N. Y.

25" } "Only Drill Press built on
32" } 'Ko-rekt' principles,
37" } Even if they come from Jersey."
42" } Gould & Eberhardt, New Ark, N. J.

Complete treatise on Screws and Screw-making, with clear and concise explanation of the methods; 95 illustrations. Price, $1.25 postpaid. E. & F. N. Spon, 12 Cortlandt St., N. Y.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton St., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

In the last year an unusually large amount of cotton was raised in the southern States, and this has tended to a reduction in price. Planters are somewhat alarmed lest the reduction in price shall make it unprofitable to raise cotton in the future. We do not believe there are any grounds for such a belief. There are thousands of people in the world who cannot get all the cotton goods they ought to have, and a little cheaper price will put them within their reach, and in the meantime the necessity for selling cheaper will lead to cheaper mechanical means for producing cotton goods.

Electric Railways in London.

The *Practical Engineer*, London, states: If we are to judge from the number of applications which are to be made in the next session of Parliament, there is going to be a boom in electric railways in London. Sanction will be sought for no less than five additional schemes for electric railways or extensions of lines already authorized. This impetus to the movement for electric locomotion is no doubt due in a large measure to the comparative success which has attended the South London Electric Railway. We use the word comparative, as, although the working of this line has proved

a great convenience to many of those who reside on that side of London, the pæans of praise have not been altogether unmixed, and sundry growls of discontent have occasionally been given expression to by belated passengers who have had the misfortune to fall within its toils when something has gone wrong. These mishaps, however, have been comparatively rare, and with enlarged experience will, we hope, become more so.

Another collision occurred on the New York Central road, January 20, which, though it did not attract much attention, no one being killed, showed the necessity for improved signaling appliances on that road just as clearly as the more notable collisions that preceded it. An express train dashed into a freight that was just taking a siding, wrecking some cars.

Some of the brilliant newspaper editors, by the way, who probably write with N. Y. Central passes in their pockets, have been entertaining us with labored arguments to prove the utter unreliability of block signals and the entire reliability of the rear brakeman with his flag, and then ending up by declaring that the road had been engaged for a long time in putting in block signals as fast as possible, and had recently ordered the entire road equipped with the unreliable and dangerous things. Consistency, thou art a jewel.

Some recently published figures of expenses of the U. S. Senate are a disgrace to that body, and would cause something of an overturning of things if we were not a marvelously patient and long-suffering people. Things are bought and paid for out of the public treasury that every one knows should be paid for by the senators themselves, if indulged in; and the funeral expenses charged when a member dies are nothing less than disgraceful. A funeral which took place quite close to Washington, and was all over in twenty-four hours, cost $2,029.58, and it was shown that each member attending must have eaten $42 worth of stuff in twenty four hours, according to the charge made for eatables. Senator Hearst's funeral cost in round numbers $20,000.

These amounts may not seem large to the millionaires who take them from the pockets of the people, but to the working people who pay them they do seem large, and it is to be hoped that these latter people will some day put an effectual stop to such performances.

We sometimes wonder if it ever occurs to our local tax makers that the rate of taxes—often varying as much as one and one-half per cent.—has a good deal to do with the location of manufacturing establishments. The difference of one and one-half per cent. is a good deal of an incubus on a manufacturing establishment, although in terms it seems small. The high rate of taxation in many eastern cities has a good deal to do with driving manufacturers to towns where taxation is abated for a term of years, and it often does this when the move is not a sound one, on general business principles. The moral is for cities to govern their affairs on business principles, keeping taxation as low as is practicable.

Notice has been given by the fire insurance companies to the authorities of Trenton, N. J., that, unless the fire department is improved, insurance rates will be increased 25 per cent. In these times it is a rather silly thing for a city to get behind in its fire department matters. The loss is sure to come upon manufacturers, and others who employ labor, from whom it is shifted to labor, and the city or town becomes an undesirable place in which to live.

Over in Jersey City some of the railroad companies are rather determined to tear up property that does not belong to them, at will, and the citizens oppose it. A pretty lively war, in the courts, is the probable outcome of the difference of opinion between the railroads and the citizens. It would be a good big blessing to the citizens to know just what rights railroad companies have in the way of tearing up streets and removing houses, but it seems to be one of the things that no man can find out.

It is announced that the American Screw Company, of Providence, has won its English patent suit, which it encountered not long ago when undertaking to manufacture screws in England, and will now put down a very large and expensive plant there for the manufacture of wood screws. The machinery, it is said, will be made here, and shipped over.

Scientists tell us that there is no material change in the weather in this country as between one year and another. But common sense and a little observation shows that little or no ice has been harvested up to this writing. Fortunately, we have—in our midst, so to speak—the ice-making machines, which will supply the deficiency.

It is believed that propellers will take the place of the magnificent side-wheel boats now in use on Long Island Sound. Harlan & Hollingworth are now building two propellers for the Stonington line, and, if successful, it is believed that no more side-wheelers will be built for service on the Sound.

The *Mail and Express* shows enterprise in its offer to publish a daily edition at Chicago during the continuance of the fair, if granted the space necessary for doing so on the grounds, and where it can be under the observance of the public. Further than this, it agrees to allow others to use its plant for a similar purpose.

The average supply of water per head in London during last year was about thirty and one-half gallons per individual. A considerably less amount, we believe, than is used in the large cities of this country.

The speck of trouble—in the air—between this country and Chili demonstrates that it is a good thing to have naval vessels at hand. But they should not be unnecessarily used.

On a recent date there were in New York harbor 532 ocean-going vessels of all kinds, of which 116 were steamers, 37 ships, 101 barks, 23 brigs and 255 schooners.

MANUFACTURES.

A new cornice works will be established at Muncie, Ind.

C. P. Hutchins is enlarging his machine plant at Freedom, Me.

The Attalla (Ala.) Hardware Company has been incorporated.

R. C. Smith is erecting a phosphate building at Pittsford, Vt.

The B. B. & K. machine shops at Bradford, Pa., are being rebuilt.

Pope, Harris & Co. will erect a shingle-mill at East Machias, Me.

The Gilbert Car Works, Green Island, Troy, N.Y., are to be enlarged.

Ground has been broken at New Haven, Conn., for a boiler factory.

An electric heat and power plant is to be erected at Marcus Hook, Pa.

An electric power and lighting plant will be erected at Wilmington, S. C.

The Ramapo (N. Y.) Iron Company is erecting another large building.

William Bartlett will erect a 100x40-foot steam mill at Kennebunk, Me.

A New York City syndicate will erect an electric plant at Wilmington, Del.

The Wiregrass Construction Company will erect steam mills at Macon, Ga.

Frank H. Elson has broken ground at New Haven, Conn., for a boiler factory.

The Reliance Wire Works Company is to erect a new plant at Milwaukee, Wis.

An electric company, capitalized at $20,000, will be established at Glenwood, Ia.

A foundry plant is to be established near Stewartstown, in Mifflin County, Pa.

The Tool Company at North Wayne, Me., is erecting a new building, 50x60 feet.

The Massachusetts Phosphate Company is erecting a phosphate plant near Acme, Fla.

A machine shop, two stories high and 40x150 feet in size will be built at Louisville, Ga.

The capacity of the Ball Engine Company, Erie, Pa., will be increased by building additions.

A stock company has been organized at Columbia, Ala., to erect a handle and spoke factory.

The Louisville & Nashville Railroad will erect car shops at Birmingham, Ala., at a cost of $40,000.

The Greensburg Rolling-mill Company, a new concern, will establish a plant at Greensburg, Pa.

A big mill for the manufacture of armor plate is to be erected near the Duquesne (Pa.) Steel Works.

The Pioneer Mining and Manufacturing Company will erect another iron furnace at Thomas, Ala.

Work has been commenced on the new works of the Bucyrus Steam Shovel Company, at Milwaukee, Wis.

The city council of Henderson, N. C., is inviting proposals for the establishment of an electric light plant.

The Perfection Knitting Machine Company, of Clearfield, Pa., has been organized. Capital stock, $18,000.

Iron works and a wood-working plant are being erected at Ashville, Ala., by Spradley, Scott and Prichett.

It is reported that the Ford Boiler Cleaner Company, of Norristown, Pa., will establish a plant at that point.

An iron foundry has been established by the International Railway Company, at Ciudad Porfirio Diaz, Mexico.

The May Thomas Hardware Company, Birmingham, Ala., has increased its capital stock from $35,000 to $50,000.

The Hutchins Machine Company, of Worcester, Mass., has commenced the manufacture of the Hall mowing machine.

The foundry of Kenyon Brothers, at Raritan, N. Y., is being rebuilt on a scale that will greatly increase the output.

The Canadian Pacific is to extend its workshops at Woodstock, N. B., and will also erect a new passenger station.

The Monroe (N. C.) Cotton-mill will, it is stated, put in an electric light plant; also double the capacity of its cotton-mill.

A machine shop is reported as to be erected at the colored State Agricultural and Mechanical College, at Raleigh, N. C.

The Lima Machine Works, of Lima, Ohio, is said to be considering the removal of its machine works to Chattanooga, Tenn.

Watertown, N. Y., is to have another manufacturing industry, in the shape of a plant to produce a new water tube boiler.

It is reported that the Steam Heater Company, of Susquehanna, Pa., will erect a new and larger machine shop next season.

A new Boston (Mass.) concern is the Wrought-iron Casting Co., of which G. D. Sargent is president. The capital is $25,000.

The axe and shovel factory, recently burned at Monmouth, Me., will be rebuilt early the coming spring, on an enlarged scale.

It is stated that the Stonemetz Printing Machine Company, of Millbury, Mass., is to remove its plant to Brooklyn, N. Y., in the spring.

The capital stock of the British Columbia Iron Works Company, Vancouver, B. C., will be increased from $100,000 to $250,000.

The Warren mill of the Trumbull Iron Company, at Warren, Ohio, is putting in a new pair of squeezers and making other improvements.

The Lancaster (Ohio) Iron Works, recently purchased by the Indiana Iron Works, of Muncie, Ind., are being removed to the latter city.

Messrs. J. P. Pettyjohn & Co., of Lynchburg, Va., are to build the Norfolk & Western machine shops and roundhouse at Lambert's Point, Norfolk.

The Malleable Iron Works Company, of Troy, N. Y., has purchased 25 acres of land in West Troy, and will begin the erection of more buildings.

The Lufkin Rule Company will remove from Cleveland, O., to Saginaw, Mich., January 5th, 1892, where they will occupy new and commodious shops.

The plant of the Wilson Aluminum Company, recently organized, and now in course of construction at Spray, N. C., will have a daily capacity of 400 pounds.

The Southern Fiber Company has been incorporated at Augusta, Ga., with a capital of $500,000, to control the patent fiber extracting machine of W. E. Jackson.

The Mammoth Manufacturing Company, of Birmingham, Ala., capital, $1,750,000, has been incorporated, for the manufacture of agricultural implements.

The Radford Pipe & Foundry Company has completed arrangements for putting in three new cranes and otherwise improving the Anniston (Ala.) Pipe Works.

The Temple Blackland Plow Co. has been organized at Temple, Tex., for the manufacture of the plow patented by L. J. C. Jackson. The capital stock is $100,000.

The Raleigh plate ice factory, which was partially burned some months ago, has been bought by Geo. R. Jarman, of Charlotte, N. C., who will operate it on an extensive scale.

The report going the rounds of the press, that the National Tube Works, of McKeesport, Pa., were to be removed to Hammond, Ind., has been officially denied by the company.

The Bain Manufacturing Company is a new organization at Bridgeport, Ala., which is considering the establishment of a plant for the manufacture of wrought-iron fencing.

Baer & Son, of Charleston, S. C., are reported as having purchased the Plate ice factory at Raleigh, N. C., and as to expend $10,000 in improving and putting same in operation.

Land has been purchased at Buffalo, N. Y., by President Hayes, of the Buffalo Cast-Iron Pipe Company, on which he will erect a new pipe works with a capacity of 60 tons a day.

The Grand Trunk has recently completed a building to be used as a rolling-mill at Montreal, and the rollers, shears and heating furnaces and other machinery are being put in.

Charles Robson, J. M. Potter, P. W. Hardin and others, have incorporated the Harris Gas Company, to erect and operate gas works, etc., at Newport, Ky. The capital stock is $5,000,000.

The Birmingham Brass Company has filed a certificate of organization at the office of the Secretary of State. The capital is $116,000, and the plant is to be located at Huntington, Conn.

The Bevington Art Metal Works, 11 to 23 South Jefferson street, Chicago, have been incorporated with a capital stock of $200,000, to manufacture articles by the Bevington welding process.

The Carolina Iron, Mining and Investment Company have been organized, with a capital stock of $1,000,000. The property consists of magnetic iron mines near Danbury, Stokes County, N. C.

The Ashland Steel Company, of Ashland, Ky., recently began to operate its new Bessemer steel plant, the first of the kind south of Maryland. The daily capacity of the new plant is 400 tons.

The Newport News & Mississippi Valley Railway Company (office, New Haven, Conn.,) will, it is stated, remove its machine shops for the Ohio Valley Division from De Koven to Henderson, Ky.

Thos. Carlin's Sons, Allegheny, Pa., who are general contractors for tools and machinery of all kinds, issue a very attractive catalogue describing a great variety of tools and machinery which they sell.

Contract has been made for an additional building for the Branch Normal College, at Pine Bluff Ark. It will be used as boiler room, blacksmith shop, foundry, machine shop and wood-working shop.

Plans have been prepared for a manufactory for the Detroit Electrical Works Company, of Detroit, Mich. The building is to be of brick, 120x136 feet, 3 stories high, and when completed will cost $20,000.

John H. Parker, F. E. Knight, Chauncey J. Weatherby, and others, of Baltimore, Md., have incorporated the Parker & Knight Co., for the manufacture of machine tools, etc. The capital stock is $25,000.

Rebuilding on a larger scale the works of the Carpenter Steel Works, at Reading, Pa., recently burned, was commenced at once, in order to fill government contracts for steel projectiles of heavy ordnance.

The Ray Valve Manufacturing Company has been incorporated, at Elizabeth, N. J. The capital is $100,000, one-half of which is already paid in, and will be used in starting works in Linden County, N. Y.

The Dutchess Tool Company write us: We have recently purchased a manufacturing plant at Fishkill-on-Hudson, N. Y., to which we have moved our entire business, and wherein we are now conducting the same.

Robert Atherton, textile machinist, who recently purchased the Franklin Mill property, which he has long occupied as lessee, in Paterson, N. J., will erect a well-equipped foundry in connection with his machine works.

The Souder Railway Freight Car Company has been incorporated at Newport, Ky., by John Smay and others, to manufacture freight cars under the patent of Jacob Souder, of Washington, D. C. The capital is $2,000,000.

The Thomson-Houston Electric Light and Power Company, through its southern agent, H. E. W. Palmer, has just completed the purchase of ground for the erection of a general southern depot and repair shops at Atlanta, Ga.

The Roanoke Iron Company, at Roanoke, Va., have completed and started their sixteen double-puddling furnaces. The plate-mill building is erected, the machinery contracted for, and operations will commence during the summer.

The Garvin Machine Company, Laight and Canal streets, New York, have issued a two-page catalogue, in which they describe milling machines, tool grinders, give a list of prices, users, etc., and inclose a calendar for the year under way.

The Baltimore & Ohio shops at Grafton, W. Va., have been materially improved lately. Several

new buildings have been erected, and general repairs made to the old ones. A 79-inch tire lathe of modern make has been put in the machine shop.

The bell foundry of A. Fulton's Son & Co., located in Pittsburgh, has been leased to the Department of Public Safety of that city, for a term of five years. It is the intention to erect a water tower to protect the lower portions of Pittsburgh from fire.

The Lowell & Suburban Street Railway Company is to erect an electric power plant in Middlesex Village, Mass. The building will be 180x130 feet, and 26 feet high. The power of the plant will be 1,500-horse, with arrangements to increase to 2,500 if necessary.

The States Machine Company, formerly at Newark, N. J., are now located at Hartford, Conn., where they occupy a new shop, 200x45, well lighted, and specially arranged to suit their requirements. The specialty of this concern is the States boring and milling machine.

The Thayer Water Gas Furnace Company, of Pittsburgh, Pa., have been chartered, with a capital stock of $5,000. The following are the incorporators of the new concern: Wm. C. Thayer, Jno. Oakley, Thad. Sumner, Jno. D. Armstrong, Robert D. King and Edward B. Scull.

There is water-works agitation in Springfield, Mass.; Warren, Mass.; Athens, Ga.; Binghamton, N. Y.; Logansport, Ind.; Guerneville, Cal.; Flushing, L. I.; Peekskill, N. Y.; Alfred Center, N. Y.; Passaic, N. J.; Athens, Ga; Cherryfield, Me.; Saratoga, N. Y., and Cambridge, Mass.

The Lawson Non-Explosive Boiler Company, of Columbus, Ohio, has been organized, for the purpose of manufacturing steam boilers and other machinery. A. H. McAlpin, Wm. Felton, H. A. Axline, Chas. G. Lord, J. C. Taylor, D. T. Lawson, S. B Campbell are the incorporators. The capital stock is $300,000.

E. L. Keller, Geo. J. Buckey, W. G. Baker and others, recently reported as having organized a stock company to manufacture plows, have incorporated as the Buckeyestown (Md.) Manufacturing Co., and will also manufacture agricultural implements, wagons, engines, stoves, castings, etc. The capital stock is $25,000.

The Kelly & Jones Company, Pittsburgh, Pa., write us: We beg to inform the trade that we have established an office at No. 104 John street, New York City (opposite Cliff street), where we will carry a line of samples of the goods of our manufacture, and also where full information and prices regarding same may be obtained.

The Webster & Perks Tool Company, of Springfield, Ohio, a new concern recently started, write us that their prospects for business seem very encouraging. They have a number of good jobs on hand, and have many orders for their reducing wheel for indicators, illustrated in our issue of December 24 They are building special machinery to order and are preparing to bring out some standard machine tools.

The Steel Sprocket Chain Works, of Beaver Falls, Pa., is now in operation. It is owned by the Harmony Society and W. A. McCool. The chains are manufactured by machinery invented by Mr. McCool. Under these patents the manufacture of steel sprocket chains, heretofore made entirely by hand, will be greatly improved. The company will employ 500 men, and will turn out from 3,000 to 5,000 feet per day.

A movement is on foot to organize a company for the establishment in the suburbs of Chicago, Ill., of a great cotton-mill, running 50,000 spindles, and giving employment to upwards of 1,000 men, women and children. At present, the scheme is represented by a charter and a stock subscription list, showing that $25,000 has been paid in. The name of the concern is the Columbia Cotton-mill Co., and to it articles of incorporation were issued at Springfield, Mass.

A certificate of incorporation of the American Fire Engine Co., of Seneca Falls, N. Y., has been filed at Albany, N.Y. The objects of the company are the manufacture and sale of steam hand fire engines, hose carriages, pumps, steam heaters and fire apparatus. The capital is $600,000, divided into shares of $100 each. The directors are Horace C. Silsby, Horace Silsby, Charles T. Silsby, Seneca Falls; Chris. Ahrens, Hiram H. Nieman, of Cincinnati, O.; Dubois Collier, of Hudson; Geo. E. Holroyd, Waterford, N. Y.

Machinists' Supplies and Iron.

NEW YORK, January 30, 1892.

Iron—American Pig—The market is still very quiet, and so far as can be seen there is no sign of improvement.

We quote Standard Northern brands, No. 1 Foundry, at $16 to $17; No. 2, $15 to $16.50; Grey Forge, $13.75 to $14.50. Southern brands of good quality are obtainable at $16 to $17.50 for No. 1 Foundry; $15.50 to $16 for No. 2; $14.25 to $14.50 for No. 3.

Scotch Pig—Coltness is quoted at $22; Eglington $20.25.

Antimony—The market is dull, and prices are somewhat lower.

We quote Hallett's, 11¼c. to 11¾c.; L. X., 12¾c.; Cookson's, 14¼c. to 15c.

Copper—The demand has been very quiet, though holders are endeavoring to maintain prices. Quotations are on a basis of 11 cents, but there have been intimations of somewhat lower prices in some transactions. Spot supplies may be obtained at 10¾ cents.

Lead—There is some improvement in the general condition of the market. In car load lots prices are 4.25c. to 4.30c.

Lard Oil—Prime City is quoted at 54c. to 55c.; Western at 53c. to 55c.

Spelter—The market is still easy, and prices are nominal at 4¾c. to 4.65 cents.

Tin—There is a slight improvement in strength. Spot supplies are quoted at 19.70c. to 19.75c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Eng. wishes constructive supervision. E., AM. M.

Wanted—Sit. by a 1st-class Am. blacksmith; mach forging pref'd. Capable, Box 223, New Britain, Ct.

Wanted—Three exp'd mech. draftsmen at once. Address Ch. Geo. D. Dutton, Springfield, Mass.

Wanted—Position by a 1st-class pattern maker and millwright; understands drafting. S. J., AM. MACH

Wanted—First-class tool dresser; steady employment at $3.00 per day; give age and reference "Milwaukee," care AMERICAN MACHINIST.

Wanted—By a mechanical engineer, with technical education and thorough practical experience, a responsible position. Box 44, AMER. MACHINIST.

A mechanical draftsman, with technical education, wishes position; has had 8 years' shop practice and competent to do all drafting. Box 42, AM. MACH

Wanted—Position as traveling salesman by practical machinist, American; 2 years on the road; engines or other machinery pref'd. Box 43, AM MACH

First-class machine shop supt. or foreman open for engagement; all kinds of heavy work, etc.; good manager of mechanics. Box 45, AM. MACHINIST.

Superintendent well up in drop forging, tempering and case hardening fence and ornamental iron work wishes an engagement with a reliable firm. T. H., AMERICAN MACHINIST.

Wanted — Situation by first-class mechanical draftsman and designer; seven years' experience on all classes of fine work. Address George D. Harrington, 5 Ripley Place, Worcester, Mass.

Wanted—Position as foreman in marine or stationary shop, by an experienced man; can work men to advantage and furnish first-class references. Address H. M. C., 957 20th, Erie Pa.

Wanted—A first-class workman that is experienced in taking charge of a shop on nice light machine work. None but a first-class man need apply. Address A. K. Z., 3032 5th Avenue, South Minneapolis, Minn.

Tool maker 32, steady, twelve years on tool work, used making of cutters, etc.; repairs to iron and wood working machinery; understand gear and rack cutting, setting up of machinery, shafting, etc. N. Y. or vicinity pref. N. Y. C., AM. MACH.

Wanted—A skilled machinist and instrument maker as Instructor and head of the Metal Working Department of the Hebrew Technical Institute, 34 and 36 Stuyvesant St., New York City. Address with references, giving full particulars.

Wanted—A machine shop foreman who is thoroughly familiar with the latest and best practice in manufacturing Duplex steam pumps; must be progressive and pushing; state other experience, age, married or single, and wages expected and references. Address Box 126, Seattle, Wash.

Mechanical draftsman wants a situation; New York or vicinity preferred. X., care of AM. MACH.

Wanted—A first-class machinist as an assistant foreman; one who has had experience in modern machine shop practice, and who can get out work cheap and accurate; good chance for right man; shop located about 100 miles from Chicago; manufacturers of engines, steam pumps and general foundry and machine business; state experience and wages. Address D. F. & M., care of AM. MACH.

+ MISCELLANEOUS WANTS +

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd-lathes & planers. S. M. York, Clev'd, O.

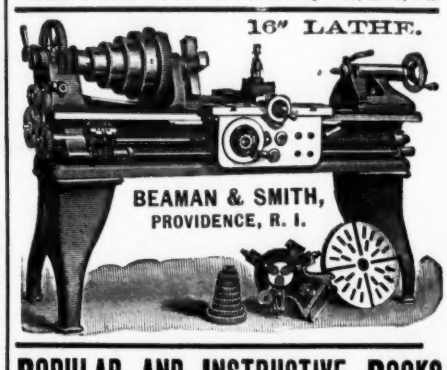
Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

STEEL TUBES
WELDLESS
SMOOTH · COLD DRAWN
John S. Leng's Son & Co. New York.

SOFT GRAY IRON CASTINGS.
From ⅛ oz. to 1000 lbs. Small Castings a Specialty. Light machinery wanted to build.
ONTARIO IRON WORKS
CANANDAIGUA, N. Y.

SENSITIVE DRILLS.
COPYRIGHTED TRADE-MARK.
Do you know
that we make
the largest,
the best,
line of Hand, Foot, and Automatic
Feed Drills for ½-inch holes and less.
Endless belts.
Short belts discarded.
Patented Improvements.
No belt tension on spindles.
1, 2, 3, 4, or more spindles.
Investigate. Read up.
84-page Catalogue free.
DWIGHT SLATE MACHINE CO.,
HARTFORD, CONN.

UNIVERSAL GRINDING MACHINES.
Hear what they say that use them:
THE CANADIAN RAND DRILL CO.,
SHERBROOKE, P. Q., CANADA, Feb. 17, 1891.
LANDIS BROS., Waynesboro, Pa.
GENTLEMEN:—The Grinding Machine purchased of you is giving entire satisfaction. We regard it as a superior tool in both design and execution.
Yours truly, CANADIAN RAND DRILL CO.,
Per F. A. HALSEY.
LODGE & DAVIS MACHINE TOOL CO.
CINCINNATI, OHIO, Sept. 6, 1891.
LANDIS BROS., Waynesboro, Pa.
GENTLEMEN:—We are pleased to inform you that the Grinding Machine reached us safely, and has now been running steadily for the last ten days, and is doing as elegant work as we ever produced, and we have two of what are considered the finest Universal Grinders in the market.
Your improved features for quick changing of feed, and the nice arrangement for changing from external to internal grinding, and in fact the whole arrangement, gives entire satisfaction, and we hope to place other orders with you from time to time as we increase our capacity.
Yours truly,
THE LODGE & DAVIS MACHINE TOOL CO.

16" LATHE.


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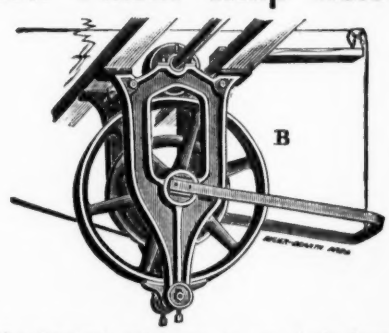
FOR ENGINEERS AND FIREMEN,
By STEPHEN ROPER, Engineer.
Embracing all branches of Steam Engineering. They are the only books of the kind ever published in this country, and are so plain that any engineer or fireman can easily understand them.
Descriptive Catalogue Mailed Free.
EDWARD MEEKS, Publisher,
No. 1012 Walnut St., PHILADELPHIA, PA.

MASON'S
New Patent Whip Hoist.


One hundred and eleven in use at the largest new Hay depots in the World, of N. Y. C. & H. R. R. Co., 33d St. & 11th Ave., New York, and Lowell M. Palmer's Docks, North 9th and 10th Sts., Brooklyn, N. Y.
Made by VOLNEY W. MASON & CO.,
PROVIDENCE, R. I.

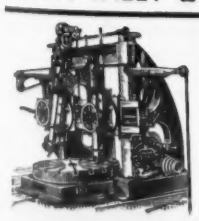
Bradley Hammers
REPUTATION.
Men test everything in this world by what it produces.
2000 IN USE
BRADLEY & COMPANY,
SYRACUSE, N. Y.
BRANCHES IN NEW YORK AND BOSTON.

GENERAL AND EXPERIMENTAL MACHINE WORK. BEST FACILITIES IN CHICAGO.
NATIONAL MACHINE WORKS, 35 S. CANAL ST. CHICAGO ILL.

WIRE:
Its Manufacture and Uses.
By J. BUCKNALL SMITH, C. E.
400 pages, 150 illustrations. 8vo., cloth, . $3.00
JOHN WILEY & SONS, New York.

Machine Tool Business For Sale.
The advertiser, desiring to give his personal attention to other business, wishes to dispose of his Machine Tool Manufacturing Business, which is well established and located in an important center for that business. Stock, Machinery and Business are worth $30,000, with contracts and agencies insuring a prosperous business. Address, MACHINE TOOLS, care of AMERICAN MACHINIST.

CHAS. A. STRELINGER & CO.,
Tools, Supplies and Machinery,
DETROIT, MICH.


BORING AND TURNING MILLS
COMBINING EVERY IMPROVEMENT.
14 SIZES—FROM 5 TO 20 FEET.
BETTS MACHINE COMPANY,
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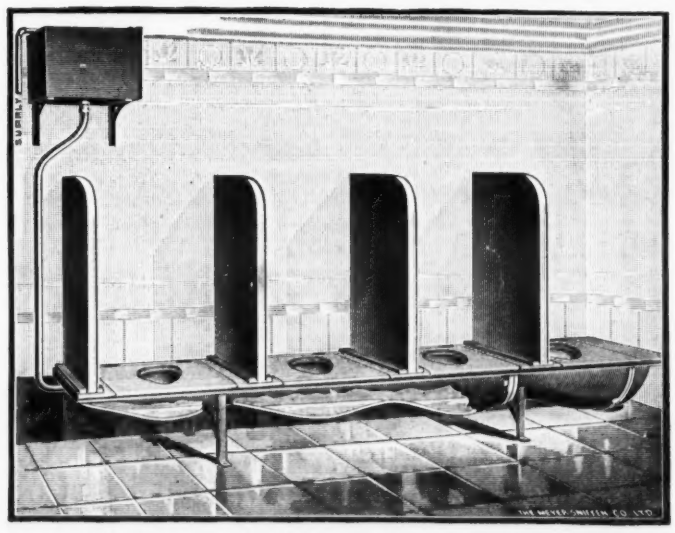
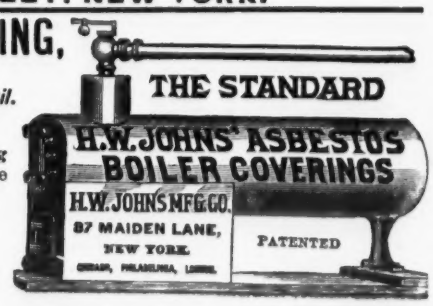
A PROPERLY CONDUCTED MANUFACTURING ESTABLISHMENT


Should provide its employees with decent Water Closet accommodations. This contemplates a simple apparatus easily kept clean and not liable to get out of order. These conditions are best met by the
EM-ESS PARSONS SCHOOL WATER CLOSET, successfully used in Schools, Factories, etc., for several years past. The arrangement of each basin in the section at a slightly lower level, with its weir or dam toward the outlet, is novel and important, securing an equal flush to each, with a minimum quantity of water—an important consideration when meter rates have to be paid. The flush is automatic at desired intervals.
For Illustrated Circular, Price List, etc., address
THE MEYER SNIFFEN CO., Ltd.
Manufacturers of
Sanitary Specialties and Superior Water Work.
46 & 48 CLIFF STREET, NEW YORK.

ASBESTOS CEMENT FELTING,
FOR LAGGING LOCOMOTIVE BOILERS.
Samples and Descriptive Price List Free by Mail.
We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.
H. W. JOHNS MANUFACTURING CO.,
87 Maiden Lane, NEW YORK.


Wanted—Specialties to build for the Southern trade. Bluefield Iron Works, Bluefield, W. Va.

Engines, special and gen. mach'y designed; ideas developed. A. W. Jacobi, 136 Liberty St., N. Y.

Special machinery designed and built. C. F. Langston & Co., 70 N. 4th St., Philadelphia.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Agent wanted in every shop; money in it. Scientific Machinist, Cleveland, Ohio. Sample copies free.

Wanted to Buy—New or 2d hand steam riveter, about 7-ft. gap. Boiler Maker, P.O. Box 324, Chicago.

Wanted—Set of second-hand Rolls; length, 14 feet or more. The Atlantic Works, East Boston, Mass.

Cheap—Two H. P. Engine Blue Prints complete. Designed to be built on an ordinary lathe. W. A. Smith & Co., 24 Custom House St., Providence, R. I.

For Sale—20 in. drill, 24-in. x 12-ft. lathe, 17-inch shaper, 12 H. P. boiler, 6 H. P. engine. Address Iron, AMERICAN MACHINIST.

Wanted to rent or sell to responsible party, machine shop and foundry; complete outfit; splendid location; terms liberal. Lock Box 158, Greenville, O.

MACHINERY
For Reducing and Pointing Wire.
ESPECIALLY ADAPTED TO POINTING WIRE RODS AND WIRE FOR DRAWING.
For Machines or Information, address the Manufacturer,
S. W. GOODYEAR, Waterbury, Ct.

New and Second-hand Machinery
AND MACHINISTS' SUPPLIES.
AT A VERY LOW FIGURE.

2 Backgeared Screw Cutting Reed Lathes, 8 ft. 4 in. long, 18 in. swing.
3 Backgeared Screw Cutting Reed Lathes, 6 ft. 2 in. long, 16 in. swing.
7 Backgeared Screw Cutting Reed Lathes, 6 ft. 4 in. long, 14 in. swing.
Above Lathes, latest improved cross-feed.
1 Universal Milling Machine, Brown & Sharpe, with complete attachmen's, cutters and spindles.
1 Wood Turning Lathe with slide rest, 26 in. swing, 10 ft. bed.
1 Pratt & Whitney Monitor Screw Machine.
1 Lathe, 6 ft. long 12 in. swing, Prentice.
1 No. 2—4 Spindle Drill Press, Garvin.
1 No. 4—4 " " "
1 Speed Lathe, 4 ft. long, 13 in. swing.
1 Lathe, " " "
1 Lathe, 3 ft. 6 in. long, 10 in. swing, Reed,
1 Shaping Machine, 16 in., Prentice.
1 Small Monitor Lathe, 3 ft. 6 in. long.
1 Power Punch Press, No. 94, E. W. Bliss.
1 Shaping Machine, 24 in. stroke, Hendey.
1 Small Universal Grinding Machine.
1 3-Spindle Drill Press, Sigourney & Co.
1 Power Press No. 2, Styles & Parker.
1 Small Lathe, 4 ft. long, 9 in. swing, Young & Co., Geared for Screw Cutting.
1 Small Emery Grinder.
1 No. 1 Diamond Emery Wheel.
1 No. 2 Tool Grinder, Springfield Emery Wheel Mfg. Co.
1 Startevant Forge.
3 Single Spindle Drill Presses, Reed.

SECOND-HAND BELTING GOOD AS NEW.

Also an assortment of Iron Split Pulleys, Lathe and Drill Chucks of all sizes, and other small tools, such as Drills, Reamers, etc.

The above being a complete assortment of machinists' tools bought and intended to be used by the Niagara Metre Co., now dissolved.

E. S. LEAYCRAFT & SON,
44 Dey St., New York.

Bound volumes for 1891. We are now prepared to take orders. Price, $4.00 per volume; express charges payable by purchaser. Address AMERICAN MACHINIST, 96 Fulton street, New York.

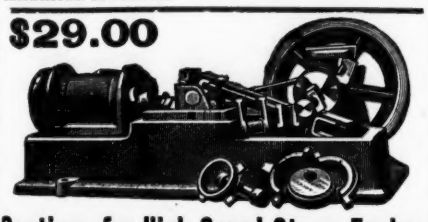
Wheel Press Wanted—Wish to correspond with parties having a good second-hand machine for sale. State capacity and other particulars. Rand Drill Co., N. Tarrytown, N. Y.

Wanted, Agency—By an exp'd mech. eng., having large acquaintance with rolling-mills, railroads, machine shops, etc. Address Fred. Hoeppner, 95 Westinghouse Building, Pittsburgh, Pa.

Wanted—Engineers to write for catalogue of all the latest and most valuable mechanical, scientific and electrical books which are given free with each barrel of the Pittsburgh Boiler Scale Resolvent. Pittsburgh Boiler Scale Resolvent Co., Pittsb'gh, Pa.

A rare opportunity is offered to a man of business ability, with $25,000 to $50,000, to invest in a young established machinery house; to the right party a lucrative position will be given, with full control of his capital; none other need apply to Box 8, AMERICAN MACHINIST.

$29.00



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CYLINDER 4 in. x 4¼ in.
T. Shriver & Co. Iron and Brass Founders,
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Sets of Castings for Engine illustrated above, with *Cast-steel Shaft, Connecting Rod* and *Rock Shaft* and *Brass Bearings*, boxed and shipped on receipt of $29.00. Three sheets *blue prints* of working drawings extra.

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For Bolts.
AS USED BY
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Send for Illus. Circular

STANDARD OIL CUPS.
FOR ENGINES & DYNAMOS.

HIGH SPEED MACHINERY.

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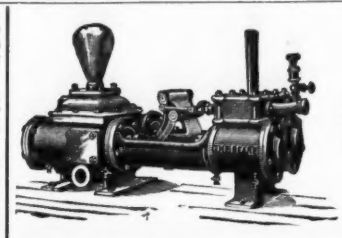
184 Washington Street,
BOSTON, MASS.



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CRESCENT STEEL CO.
PITTSBURGH. CHICAGO. NEW YORK.
NOW USED FOR **TOOLS, DIES, MILLING CUTTERS, &C.**

THE DEANE
OF HOLYOKE
STEAM PUMPS
DEANE STEAM PUMP CO.,
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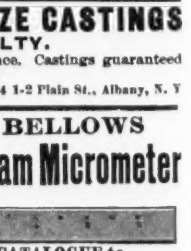
Improved Screw Cutting Foot and Power. **LATHES**
Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.
THE SEBASTIAN-MAY CO.,
167 to 175 Highland Avenue, SIDNEY, OHIO.
MONTGOMERY & CO., 105 Fulton St., New York, Gen'l Agents.



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LIGHTNING AND GREEN RIVER SCREW PLATES.

Tap Wrenches, Bolt Cutters, Hand and Power Drilling Machines, Punching Presses and Other Labor-Saving Tools.
WILEY & RUSSELL MFG. CO., Greenfield, Mass. SEND FOR NEW CATALOGUE.

The Hackney Power Hammer

The Measure of Excellence and Profit.

The durability of the machine and the quantity—with quality—of work produced, is nowadays the measure of excellence and profit, and in this respect the "Hackney" is far in the lead.

It surpasses other power hammers in durability, speed and quality of work.

Write for catalogue and prices.
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JESSOP'S STEEL
MANUFACTORY,
WILLIAM JESSOP & SONS, LD. | SHEFFIELD, ENGLAND. | Chief American Office, 91 JOHN ST., NEW YORK.

For TOOLS, DRILLS, DIES, &C.
All Kinds in Stock.
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R. MUSHET'S SPECIAL and TITANIC STEELS.
How to get the best results with "R. MUSHET'S SPECIAL STEEL." Greatly increase your speeds and feeds; then compare the work you turn off with that done by any other known Steel. This will make the first cost of "Mushet's" look insignificant.
B. M. JONES & CO.,
Sole Representatives in the United States.
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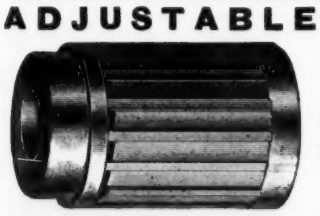
ADJUSTABLE BLADED REAMERS
IN STOCK AND TO ORDER.



When worn, Blades can be removed, reground, and readjusted to retain the original cutting diameter.
R. D. NUTTALL COMPANY, Allegheny, Pa.
MANUFACTURERS OF
Special Machinery and Tools. Gear Cutting to Order.

Fitchburg Machine Works,
MANUFACTURERS OF THE CELEBRATED
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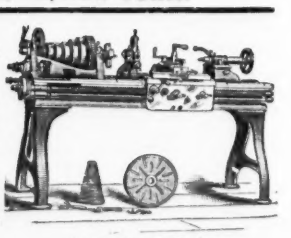

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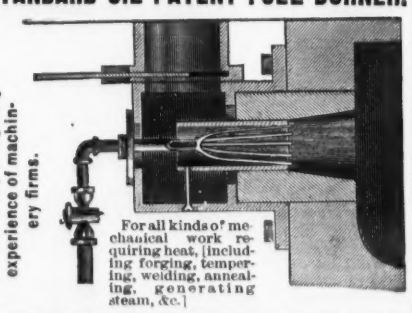

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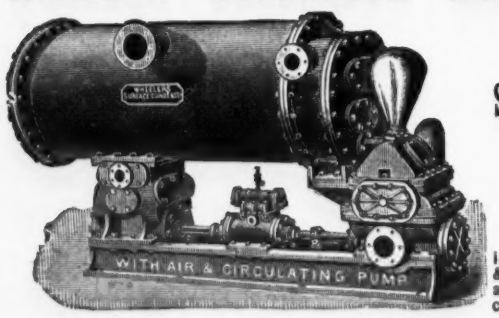

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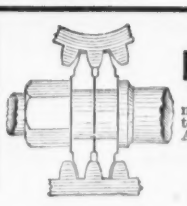

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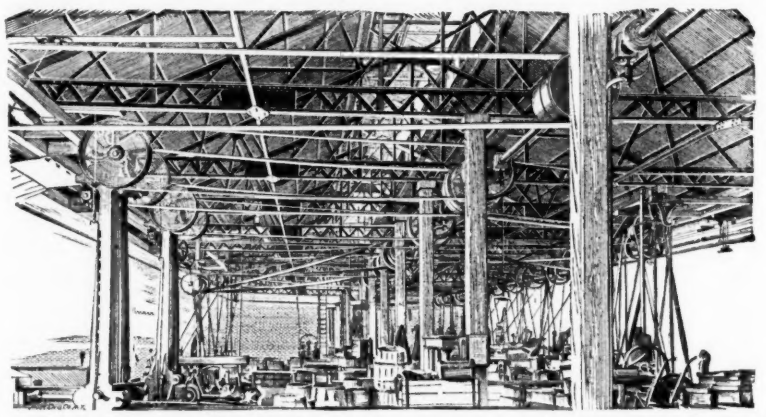

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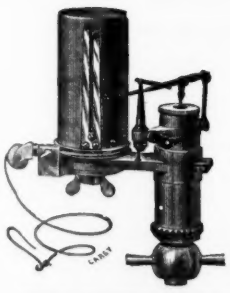

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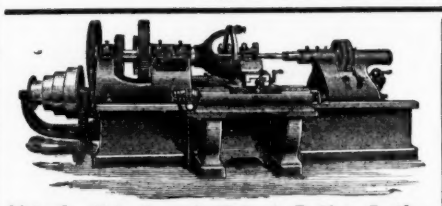

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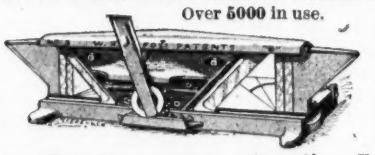

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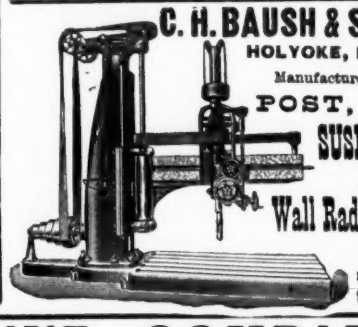

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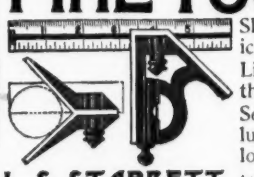

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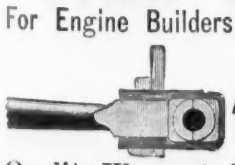

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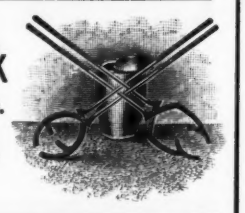

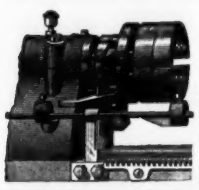

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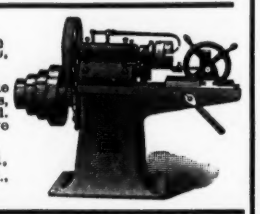

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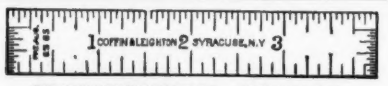

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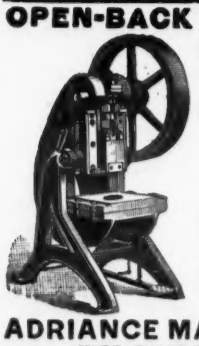

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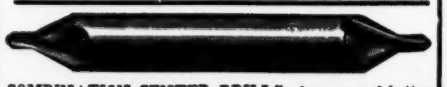

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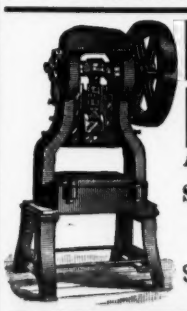

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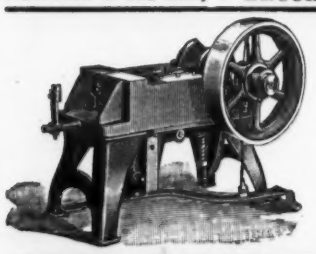

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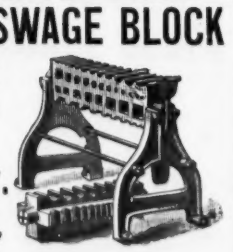

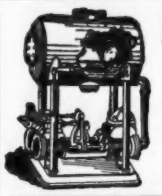

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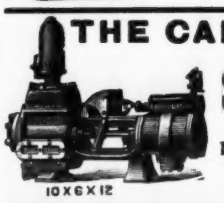

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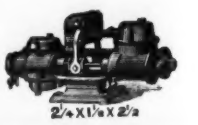

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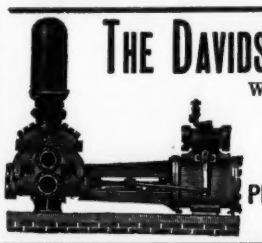

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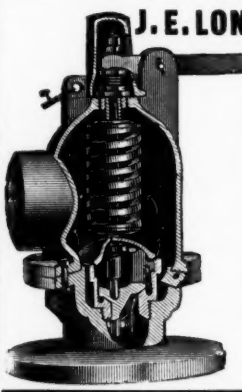

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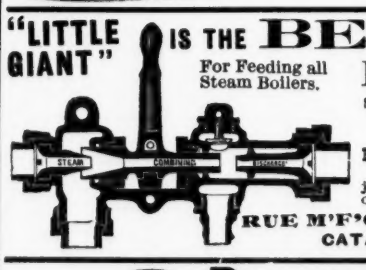

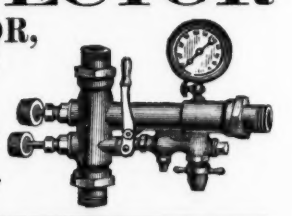

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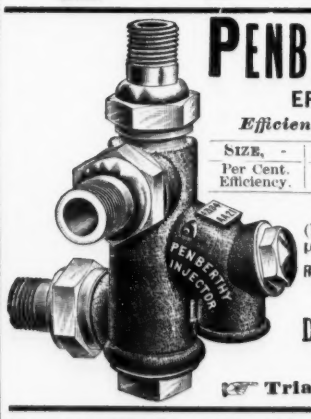

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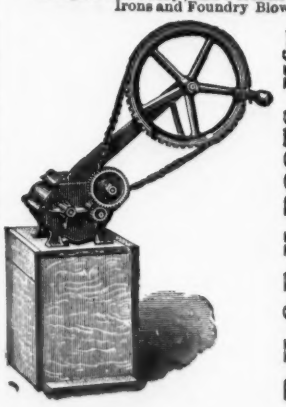

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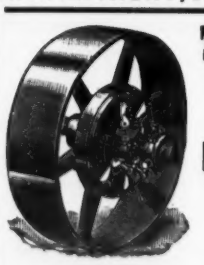

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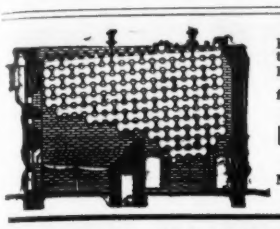

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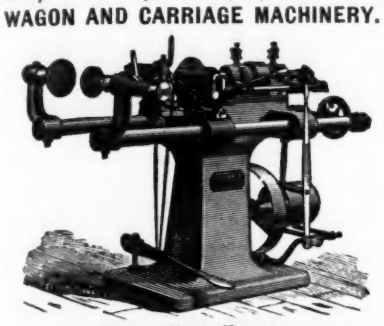

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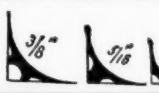

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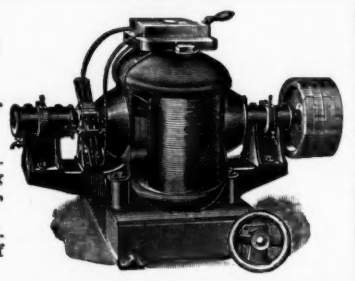

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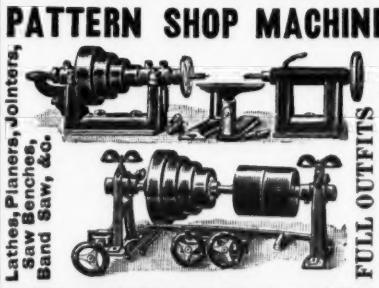

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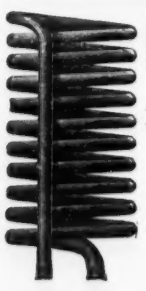

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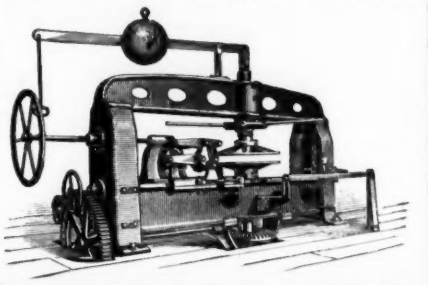

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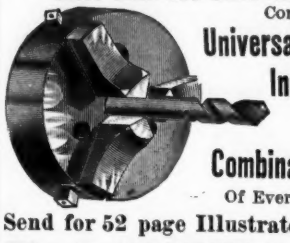

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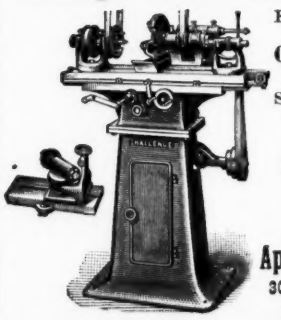

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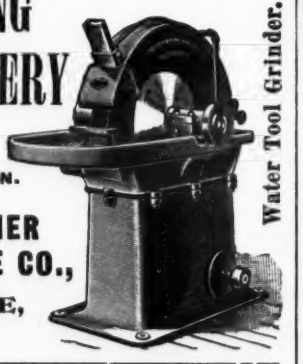

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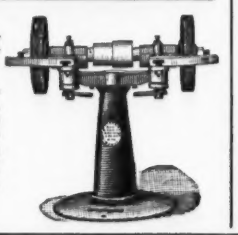

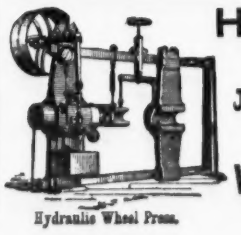

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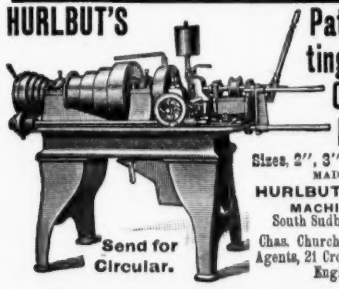

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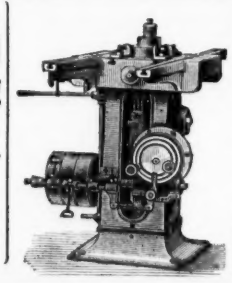

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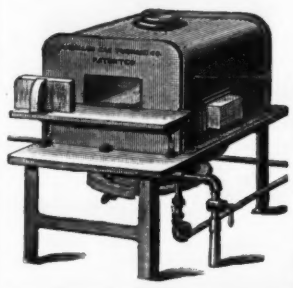

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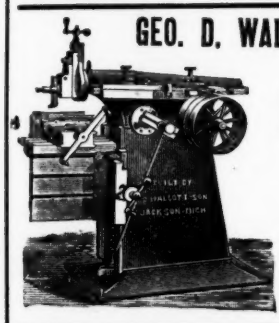

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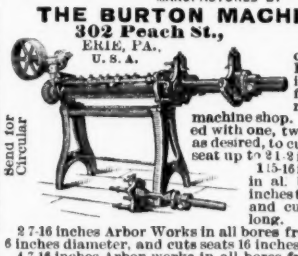
THE ERIE KEY-SEATING MACHINE.
MANUFACTURED BY
THE BURTON MACHINE CO.,
302 Peach St.,
ERIE, PA., U. S. A.



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The cut represents our Stationary and Portable Key-seating Machine, which fully meets all the requirements of a machine shop. They are furnished with one, two or three Arbors, as desired, to cut any width of key-seat up to 2 1-2 inches wide.

1 15-16 inches Arbor works in all bores from 1 15-16 inches to 3 inches diameter and cuts seats 13 inches long.

2 7-16 inches Arbor Works in all bores from 2 7-16 inches to 6 inches diameter, and cuts seats 16 inches long.

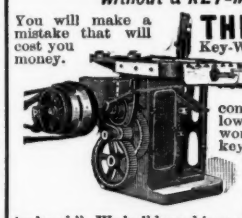
4 7-16 inches Arbor works in all bores from 4 7-16 inches to 14 inches diameter, and cuts seats 26 inches long.

With an attachment for the purpose, seats can be cut in holes as small as 1 inch diameter, by one passage of the cutter.

If the work is heavy and too large to be placed on machine it can be detached from stand and used as portable machine.

If you buy a KEY-WAY CUTTER without a KEY-MAKING ATTACHMENT

You will make a mistake that will cost you money.



THE MORTON Lightning Key-Way Cutter is the only machine on the market that will cut a Key-Way and make a Key to fit it. Mr. Geo. Newcomb, Salem, Mass., says as follows: "The Key-maker is a wonderful attachment, making keys faster than a man can cut off the steel for it. The Key-Way Cutter does a piece of work in fifteen minutes which requires my man seven hours to accomplish by hand." We build machines with stroke varying from six inches to five feet, and cutting from the smallest Key-ways to six inches wide.

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☞ All Without Extra Charge.
☞ WRITE FOR CUTS WITH FULL DESCRIPTIONS

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REAR VIEW OF LATHE SHOWS GENERAL DESIGN OF OUR TAPER ATTACHMENT. FURNISHED WITHOUT EXTRA CHARGE ON ALL STANDARD ENGINE LATHES.

☞ See Advertisement on page 20. ☜

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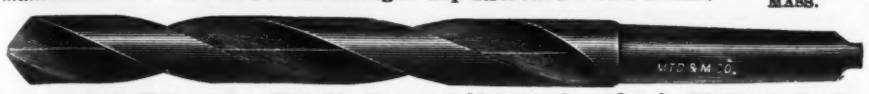

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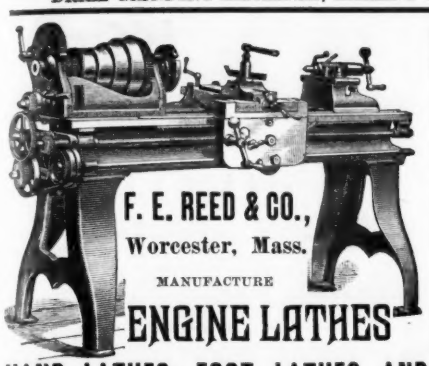

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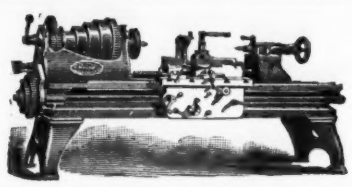

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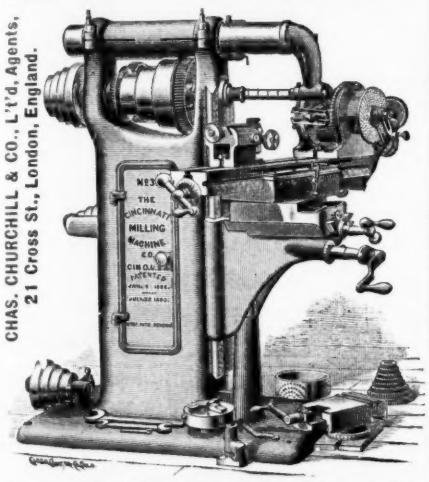

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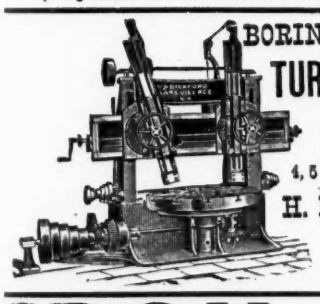

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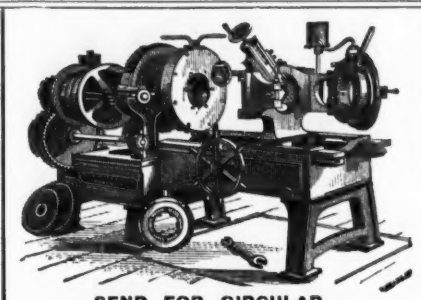

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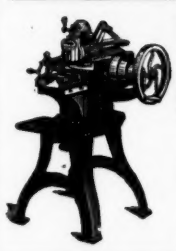

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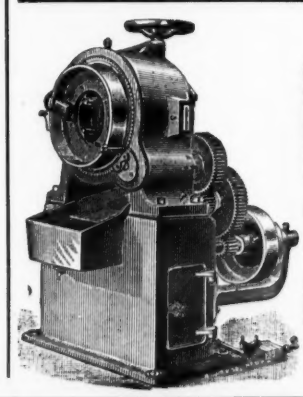

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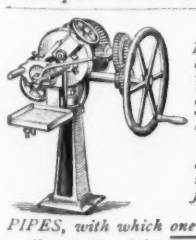

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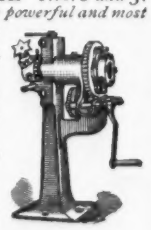

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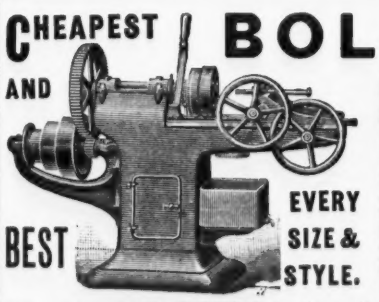

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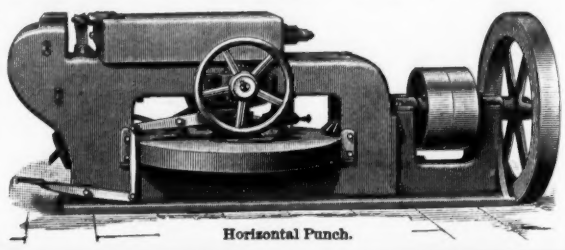
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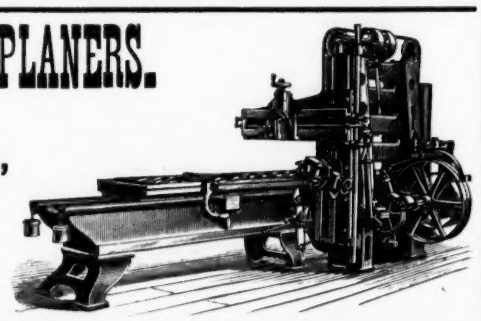

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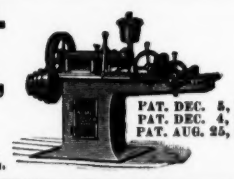
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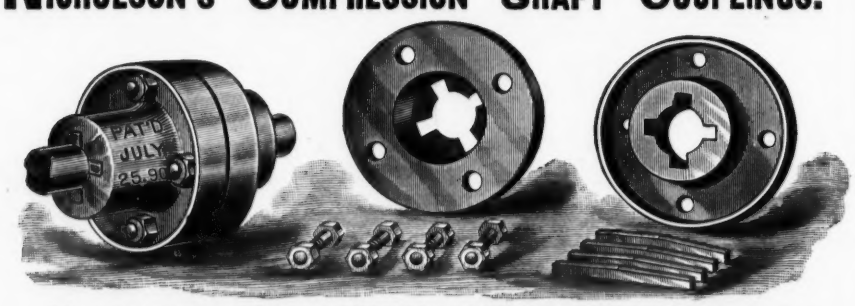

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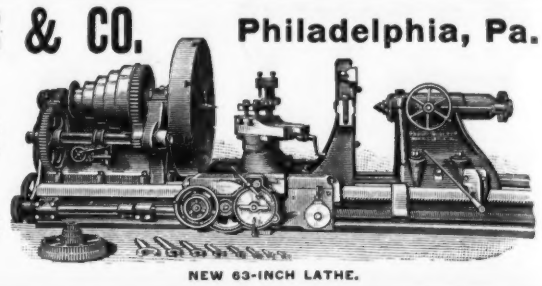
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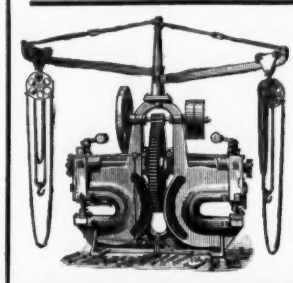

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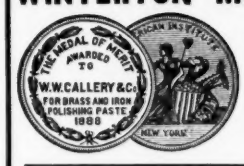

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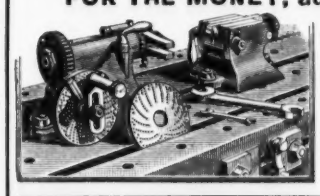
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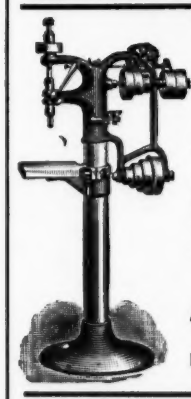
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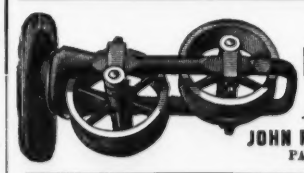
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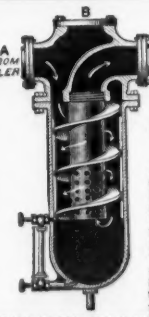

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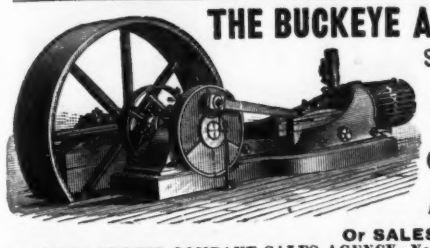

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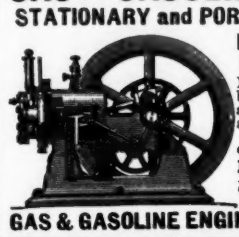

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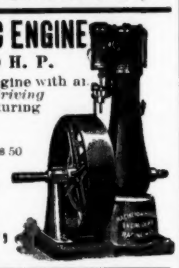

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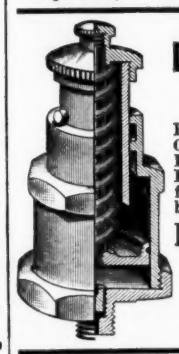

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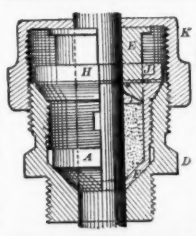

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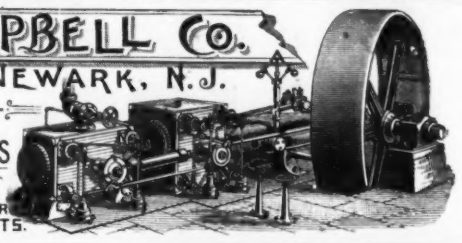

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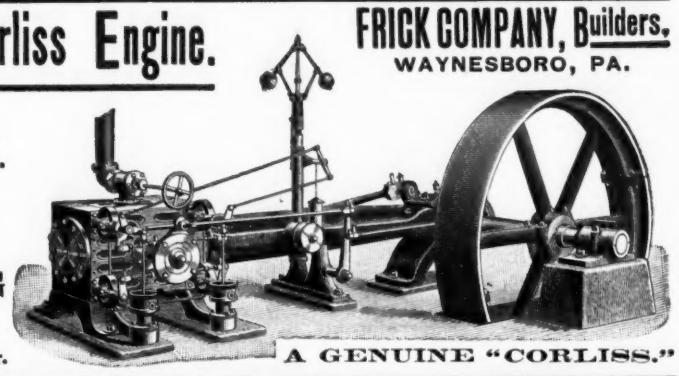

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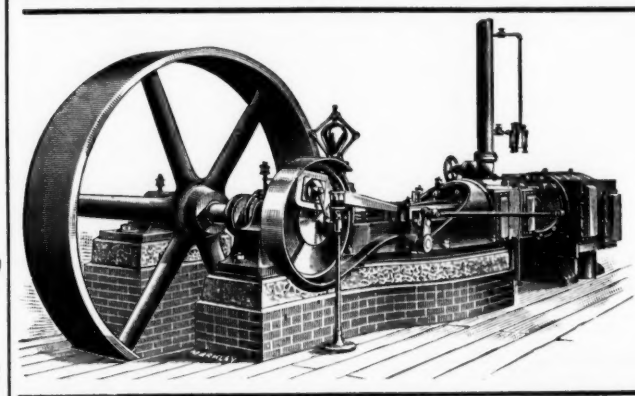

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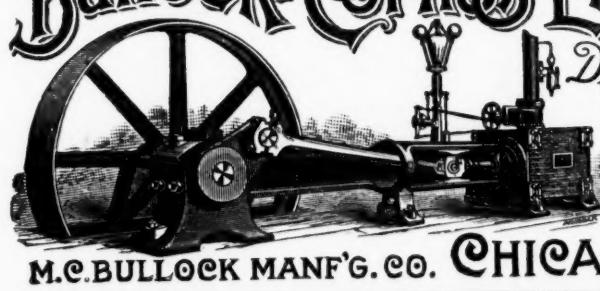

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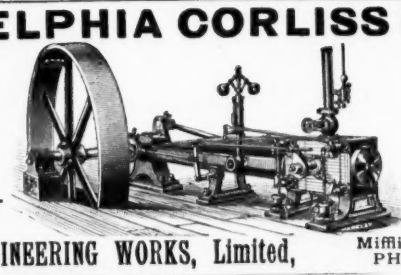

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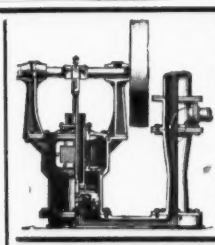

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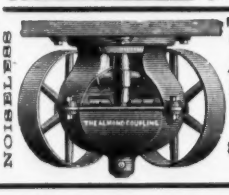

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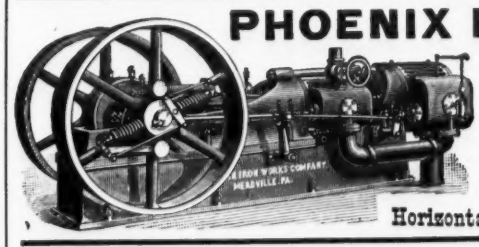

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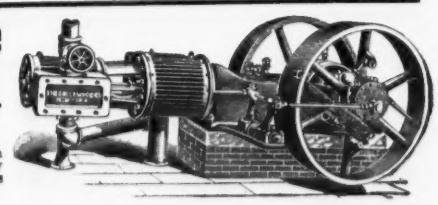

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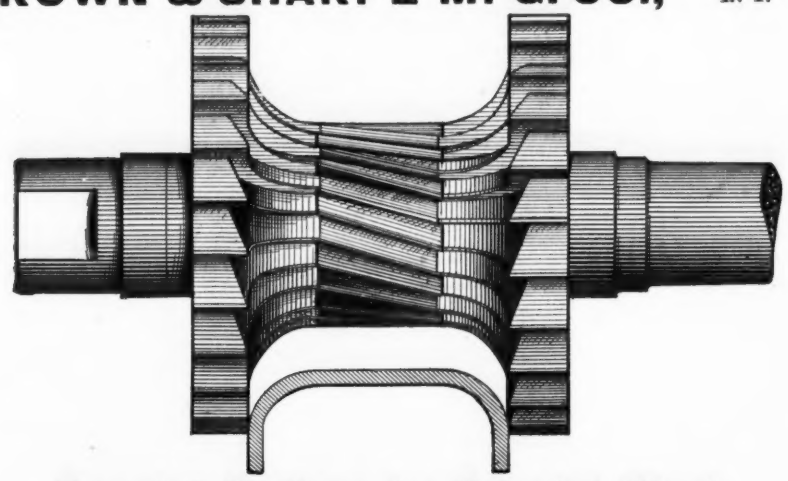

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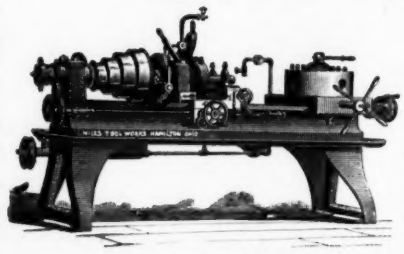

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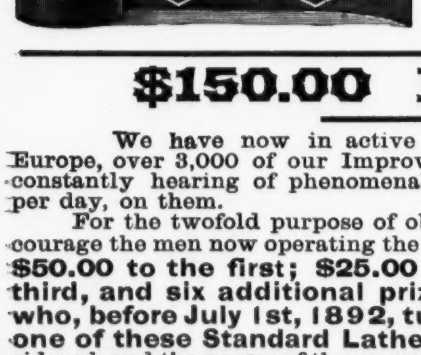

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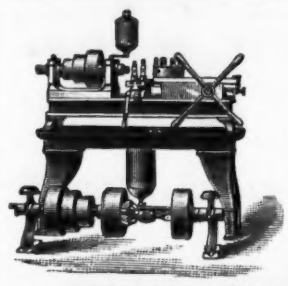

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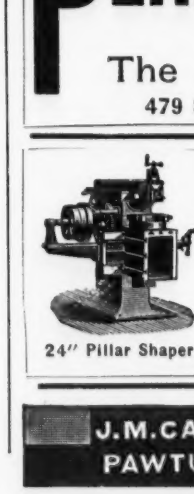

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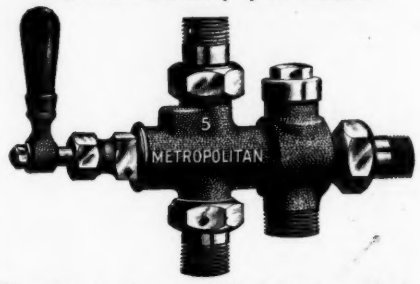

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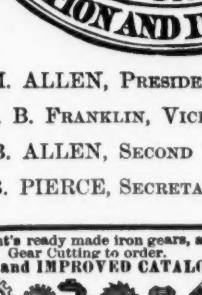

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